



# LENOIR COUNTY COURTHOUSE PROJECT MANUAL

Devita Project #22175-03

December 21, 2022

SECTION 00-01-07

SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

MECHANICAL  
ENGINEER

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The following Divisions:  
Division 26



END OF DOCUMENT 000701



LENOIR COUNTY COURTHOUSE  
HVAC AND BASEMENT RENOVATIONS  
130 SOUTH QUEEN STREET  
KINSTON, NC 28501  
DEVITA PROJECT # 22175-03

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**SECTION 00100 - INVITATION TO BID**

Sealed proposals will be received by **2:00 pm Friday September 15, 2023**, at the Lenoir County Courthouse / County Commissioner's Chamber, 130 South Queen Street, Kinston, NC, for furnishing of labor, materials, and equipment for the

**Lenoir County Courthouse  
HVAC and Basement Renovation Project  
130 South Queen Street  
Kinston, Lenoir County, NC 28501**

project in accordance with the construction documents prepared by  
*DeVita & Associates, Inc (Engineer) & Dunn & Dalton Architects, P.A.*

Bids shall be addressed and delivered to:

**Mr. Adam Short, Assistant County Manager and Planning and Inspections Director  
Lenoir County Courthouse  
HVAC and Basement Renovation Project  
130 South Queen Street  
Kinston, Lenoir County, NC 28501 (FedEx/UPS)**

**Or**

**Mr. Adam Short, Assistant County Manager and Planning and Inspections Director  
Lenoir County Courthouse  
HVAC and Basement Renovation Project  
PO Box 3289  
Kinston, Lenoir County, NC 28502 (USPS)**

The bids will be publicly opened.

A PRE-BID CONFERENCE will be held at the Courthouse Building at **2:00 pm Tuesday, August 15, 2023. Attendance is mandatory.**

The basis of the contract will be a Single Prime General Contract.

A Bid Bond in the amount of 5% of the base bid will be required with each bid.

A Performance and Payment Bond will be required to be included in the bid.

The Owner reserves the right to reject any or all bids and to waive informalities.

**END OF SECTION 00100**

**INSTRUCTIONS TO BIDDERS**

Invitation to bid for the following PROJECT:

**Lenoir County Courthouse  
HVAC and Basement Renovations  
130 South Queen Street  
Kinston, NC 28501**

**THE OWNER:**

Lenoir County, NC

**THE ENGINEER:**

DeVita & Associates, Inc.  
205 Regency Executive Park Drive  
Suite 315  
Charlotte, NC 28217  
(704) 335-0396

**THE ARCHITECT:**

Dunn & Dalton Architects, P. A.  
401 N. Herritage Street  
Kinston, NC 28501  
(252) 527-1523

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## INSTRUCTIONS TO BIDDERS

### ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, the bid form, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, Specification Section 00797, or in other Contract Documents are applicable to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Engineer/Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

### ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 The Bidder by making a Bid represents that:

§ 2.1.1 The Bidder has read and understands the Bidding Documents or Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being bid concurrently or presently under construction.

§ 2.1.2 The Bid is made in compliance with the Bidding Documents.

§ 2.1.3 The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.

§ 2.1.4 The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.

§ 2.1.5 The Bidder is a Contractor licensed to do business in the state of North Carolina and whose license number appears in the space provided on the Form of Proposal.

## INSTRUCTIONS TO BIDDERS

### ARTICLE 3 BIDDING DOCUMENTS

#### § 3.1 COPIES

§ 3.1.1 Bidders will be provided a link to the electronic bid documents.

§ 3.1.2 Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Engineer/Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

#### § 3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

§ 3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Engineer/Architect errors, inconsistencies or ambiguities discovered.

§ 3.2.2 Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Engineer/Architect at least seven days prior to the date for receipt of Bids.

§ 3.2.2.1 Document Clarification Form located in Section 00215 are to be submitted to the Engineer/Architect.

§ 3.2.3 Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.

#### § 3.3 SUBSTITUTIONS

§ 3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

§ 3.3.2 No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Engineer/Architect at least ten days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Engineer/Architect's decision of approval or disapproval of a proposed substitution shall be final. It shall not be incumbent upon the Owner and/or the Engineer/Architect to consider any items submitted for substitution but only those, in their judgment, meriting consideration. All requests for substitution by Sub-bidders or Material Suppliers will be considered only when made and approved through a qualified Bidder and when submitted with sufficient information to evaluate the product/materials being submitted. All requests shall comply with the following:

1. The equipment and/or product submitted must be equal in all ways to the specified equipment or product. The Engineer/Architect will make the final decision.
2. The proposer of the substitution of equipment or product shall identify any delay to the schedule for work, inspections, or tests which might result from the use of the proposed substitution.

The proposer of the substitution of equipment or product shall identify any delay to the schedule for work, inspections, or tests which might result from the use of the proposed substitution.



## INSTRUCTIONS TO BIDDERS

§ 3.3.3 If the Engineer/Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

§ 3.3.4 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents. The Owner and the Engineer/Architect will consider a formal request for substitution, as indicated in Section 01631 - Product Substitutions of products in place of those specified prior to the signing of the Owner/Contractor Agreement only. No substitutions unless otherwise noted will be allowed after the Contract has been signed.

§ 3.3.5 Time limits in Subparagraph 3.3.2 for substitutions shall be based on the original receipt of Bids date as established in the Invitation To Bid or the Advertisement For Bid.

### § 3.4 ADDENDA

§ 3.4.1 Addenda will be transmitted to all who are known by the issuing office to have received a complete set of Bidding Documents.

§ 3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

## ARTICLE 4 BIDDING PROCEDURES

### § 4.1 PREPARATION OF BIDS

§ 4.1.1 Bids shall be submitted on the forms included with the Bidding Documents. The Form of Proposal included in the Project Manual is for reference only and shall not be removed but it may be reproduced by the Bidder.

§ 4.1.2 All blanks on the bid form shall be legibly executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.

§ 4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall make no additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. The Bidder shall provide evidence of legal authority to perform within the jurisdiction of the Work. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid

**INSTRUCTIONS TO BIDDERS**

submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

**§ 4.1.8** The Contractor shall provide the names of Subcontractors, persons, or entities (including those who are to furnish materials and/or equipment fabricated) proposed for all portions of the Work as indicated on the Bid form.

Failure to include said list will cause said bid to be non-responsive which may result in rejection of said bid by the Owner.

**§ 4.2 BID SECURITY**

**§ 4.2.1** Each Bid shall be accompanied by a bid security in the form and amount required if so stipulated in the Instructions to Bidders. The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. The amount of the bid security shall not be forfeited to the Owner in the event the Owner fails to comply with Section 6.2.

**§ 4.2.2** If a surety bond is required, it shall be written on AIA Document A310, Bid Bond, unless otherwise provided in the Bidding Documents, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.

**§ 4.2.3** The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected.

**§ 4.2.4** Bids shall be accompanied by a cash-deposit or a certified check drawn on and certified by a bank or trust company insured by the Federal Deposit Insurance Corporation, in an amount not less than 5 percent of the bid, or in lieu thereof, a bidder may offer a bid bond in the amount of 5 percent of the bid executed by a corporate surety licensed under the laws of the state in which the project is located to execute such bond and listed on the latest U.S. Treasury Department list of companies holding certificates of authority as acceptable sureties on Federal Bonds. Form of bond shall be AIA Document A310. Should the bidder fail or refuse to enter into a Contract with the Owner within ten calendar days of receipt of the Contract for signature, or should the Bidder fail or refuse to furnish the Performance and Labor and Material Payment Bonds AIA Document A312, then the bid security shall be forfeited to the Owner.

**§ 4.2.5** Certified checks and/or Bid Bonds shall be pinned or clipped to the Proposal Form.

**§ 4.3 SUBMISSION OF BIDS**

**§ 4.3.1** All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

Proposals shall be received by the specified time to the place indicated herein by a representative of the Bidder. The outside of the envelope shall be as indicated below:

**INSTRUCTIONS TO BIDDERS**

**Lenoir County Courthouse  
HVAC and Basement Renovations  
130 South Queen Street  
Kinston, NC 28501**

§ 4.3.2 Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.

§ 4.3.3 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.4 Oral, telephonic, telegraphic, facsimile or other electronically transmitted bids will not be considered.

**§ 4.4 MODIFICATION OR WITHDRAWAL OF BID**

§ 4.4.1 A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid. No bid may be withdrawn after the scheduled closing time for receipt of bids for a period of ninety (90) days.

§ 4.4.2 Prior to the time and date designated for receipt of Bids, a Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder. Written confirmation over the signature of the Bidder shall be received, and date- and time-stamped by the receiving party on or before the date and time set for receipt of Bids. A change shall be so worded as not to reveal the amount of the original Bid. Proposals may be modified by an authorized representative of the bidder **IN PERSON AT PLACE OF BID OPENING PRIOR TO TIME OF OPENING BIDS ONLY**. Modifications submitted by any other means **WILL NOT BE CONSIDERED**.

§ 4.4.3 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

§ 4.4.4 Bid security, if required, shall be in an amount sufficient for the Bid as resubmitted.

**ARTICLE 5 CONSIDERATION OF BIDS**

**§ 5.1 OPENING OF BIDS**

All Bids will be publicly opened.

**§ 5.2 REJECTION OF BIDS**

The Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

**§ 5.3 ACCEPTANCE OF BID (AWARD)**

§ 5.3.1 It is the intention of the Owner to award the contract to the responsive and responsible bidder submitting the proposal most favorable to the Owner and whose construction skill and financial resources are fully equal to the task of prosecuting the work in a rapid and satisfactory manner, and of completing the work within the time limit.

§ 5.3.2 The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the contract award.

**INSTRUCTIONS TO BIDDERS**

**§ 5.3.3** Bidders shall be required to have successfully completed projects of a similar scope and complexity. If requested by the Owner, Bidders shall submit the names and phone numbers of the Owner's representatives for these projects.

If any Bidders cannot furnish information verifying that he has the required experience then his Bid shall be considered as non responsive and therefore rejected.

The Bidder shall submit the name of the superintendents (office manager and project manager) that will be assigned to the project.

**ARTICLE 6 POST-BID INFORMATION****§ 6.1 CONTRACTOR'S QUALIFICATION STATEMENT**

Bidders to whom award of a Contract is under consideration shall submit to the Engineer/Architect, upon request, a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

**§ 6.2 SUBMITTALS**

**§ 6.2.1** The Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, after notification of selection for the award of a Contract, furnish to the Owner through the Engineer/Architect in writing:

- .1 a designation of the Work to be performed with the Bidder's own forces;
- .2 names of the manufacturers, products, and the suppliers of principal items or systems of materials and equipment proposed for the Work; and
- .3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.
- .4 provide documentation in accordance with specification section 00102 "Special Instructions to Bidders – Minority and/or Women Business Enterprise (M/WBE) Program- Bidding Procedures"; documentation shall include (1) affidavit C or affidavit D (2) letters of intent.

**§ 6.2.2** The Bidder will be required to establish to the satisfaction of the Engineer/Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

**§ 6.2.3** Prior to the execution of the Contract, the Engineer/Architect will notify the Bidder in writing if either the Owner or Engineer/Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Engineer/Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, (1) withdraw the Bid or (2) submit an acceptable substitute person or entity with an adjustment in the Base Bid or Alternate Bid to cover the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

**§ 6.2.4** Persons and entities proposed by the Bidder and to whom the Owner and Engineer/Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Engineer/Architect.

**ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND****§ 7.1 BOND REQUIREMENTS**

**§ 7.1.1** The Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder's usual sources. A Performance Bond and Labor and Material Payment Bond shall be required of the Contractor by the Owner in the full amount of the Contract price. Form of required Bonds shall be AIA Document 312. No other forms of Performance and/or Payment Bond will be accepted

**INSTRUCTIONS TO BIDDERS**

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 If the Owner requires that bonds be secured from other than the Bidder's usual sources, changes in cost will be adjusted as provided in the Contract Documents.

**§ 7.2 TIME OF DELIVERY AND FORM OF BONDS**

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner with the executed Contract. If the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond. Both bonds shall be written in the amount of the Contract Sum.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

**ARTICLE 8 TAXES**

§ 8.1 Each party shall be responsible for payment of any and all federal, state, local or other taxes which may arise or be imposed as the result of its performance under this Agreement or as the result of the receipt of any compensation or other funds under this Agreement or in connection with the transactions contemplated hereby, if any. This Section shall survive termination of this Agreement.

**ARTICLE 9 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR**

Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment Is a *Stipulated Sum*.

**END OF SECTION 00101**

**FORM OF SINGLE PRIME CONTRACT PROPOSAL**

PROPOSAL SUBMITTED BY \_\_\_\_\_

ADDRESS \_\_\_\_\_

\_\_\_\_\_

TELEPHONE NO. (\_\_\_\_) \_\_\_\_\_

LICENSE NO. \_\_\_\_\_

BIDDING AS: **CONTRACTOR**  
TO: **Lenoir County Manager**  
Lenoir County, NC

The Undersigned, having examined, compared, and familiarized himself with the Invitation to Bid, the Instructions to Bidders, Special Instructions to Bidders (M/WBE) program, and the Contract Documents as prepared by DeVita & Associates, Inc. (Engineer) and Dunn & Dalton Architects, P.A., and having examined the site of the Work and familiarized himself with all conditions and requirements pertaining thereto, hereby proposes to furnish all material, labor, equipment, services, and transportation necessary to complete the work in accordance with the Contract Documents for the Project entitled:

**Lenoir County Courthouse  
HVAC and Basement Renovations  
130 South Queen Street  
Kinston, NC 28501**

for the sum(s) of:

**BASE BID: CONTRACT**  
**(Allowance #1 in the amount of \$100,000 is not included in this base bid)**

\_\_\_\_\_ Dollars (\$\_\_\_\_\_).

The undersigned further proposes to undertake work on the Date of Commencement as established in the Agreement and shall achieve Substantial Completion within not more than **eighteen (18) months** from the Notice to Proceed. The successful bid Contractor shall provide an outline project construction schedule when requested by the Owner, prior to execution of a construction contract, showing how this timeline will be met.

Liquidated damages will be assessed in the amount of \$250/ day for the first (30) thirty days beyond substantial completion and \$500/day for the remainder of days beyond the first (30) days after substantial completion.

**ALTERNATE #1: Work in the basement**

ADD \$\_\_\_\_\_ Dollars (\$\_\_\_\_\_).

The undersigned confirms that he has attached the specified bid security and that in the event should he fail or refuse to enter into a contract with the Owner, such bid security will be forfeited to the Owner as liquidated damages.

**UNIT PRICES #1 - #4: Hourly rate premiums** for working outside of normal working hours, in the courtroom, as may be required to meet above referenced schedule. Normal work hours as defines as 7am to 6pm Mon though Fri.

#1 ADD \$ \_\_\_\_\_/hour for \_\_\_\_\_ trade category

#2 ADD \$ \_\_\_\_\_/hour for \_\_\_\_\_ trade category

#3 ADD \$ \_\_\_\_\_/hour for \_\_\_\_\_ trade category

#4 ADD \$ \_\_\_\_\_/hour for \_\_\_\_\_ trade category

The undersigned acknowledges that he has received and reviewed the below enumerated addenda and has taken them into account in the preparation of this proposal.

Addendum No. \_\_\_\_\_ dated \_\_\_\_\_.

Addendum No. \_\_\_\_\_ dated \_\_\_\_\_.

Addendum No. \_\_\_\_\_ dated \_\_\_\_\_.

Addendum No. \_\_\_\_\_ dated \_\_\_\_\_.

Addendum No. \_\_\_\_\_ dated \_\_\_\_\_.

Respectfully submitted this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_  
without conditions by:

\_\_\_\_\_  
(Name of Firm or Corporation making bid)

By: \_\_\_\_\_

\_\_\_\_\_  
Title: (Owner, Partner, or Corp. Pres. or Vice-Pres. Only).

WITNESS:  
\_\_\_\_\_  
(Proprietorship or Partnership)

ATTEST:

By: \_\_\_\_\_

\_\_\_\_\_  
Title: (CORPORATE SEAL)

**For All Official Notices**

\_\_\_\_\_  
Name and Title

\_\_\_\_\_  
Name of Firm/Corporation

\_\_\_\_\_  
Street Address

\_\_\_\_\_  
City, State and Zip

\_\_\_\_\_  
Area Code and Telephone

\_\_\_\_\_  
Bonding Company Attorney-In-Fact Manager

\_\_\_\_\_  
Area Code and Telephone

**MINORITY AND/OR WOMEN BUSINESS ENTERPRISE (M/WBE) PROGRAM:**

The General Contractor states that his bid includes the following documentation based on the requirements of Specification Section 00495 "Minority and/or Women Business Enterprise (M/WBE) Program- Bidding Procedures".

Documents Included in Bid:

1. Identification of Minority/Women Business Participation form.
2. Affidavit A (if subcontracting)
- OR**
3. Affidavit B (if self-performing)

**END OF SECTION 00400**



## SECTION 00495

## MINORITY BUSINESS CONTRACT PROVISIONS

I APPLICATIONS

Pursuant to General Statutes of North Carolina Sections, G.S. 142-128.2 and G.S. 143-128.4, Lenoir County encourages and provides equal opportunity for Certified Minority and Woman-Owned Business Enterprise (MWBE) businesses to participate in all aspects of the County's contracting and procurement programs to include - Professional Services; Goods and Other Services; and Construction. The prime contractor will be required to identify participation of MWBE businesses in their proposal, and how that participation will be achieved.

The **Guidelines for Recruitment and Selection of Minority Businesses for Participation in the Lenoir County Contracts** are attached and are hereby made a part of these contract documents. These guidelines shall apply to all contractors regardless of ownership. The State Guidelines for Recruitment and Selection of Minority Businesses may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 733-7962, Website: <http://www.doa.state.nc.us/hub/index.htm>.

The goals for participation by minority firms as subcontractors on this project have been set at 10%.

The bidder must identify on its bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit (Affidavit A) listing good faith efforts or affidavit (Affidavit B) of self performance of work, if the bidder will perform work under this contract by its own workforce, as required by G.S. 143-128.2© and G.S. 143-128.2(f).

The lowest responsible, responsive bidder must provide Affidavit C, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal.

**OR**

Provide Affidavit D, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, **with documentation of Good Faith Effort, if the percentage is not equal to the applicable goal.**

**OR**

Provide Affidavit B, which includes sufficient information for the State to determine that the bidder does not customarily subcontract work on this type of project.

**The above information must be provided as required. Failure to submit these documents is grounds for rejection of the bid.**

II MINIMUM COMPLIANCE REQUIREMENTS

All written statements, affidavits or intentions made by the bidder shall become a part of the agreement between the Contractor and Lenoir County for the performance of this contract. Failure to comply with any of these statements, affidavits or intentions, or minority business

Guidelines shall constitute a breach of the contract. A finding by Lenoir County that any information submitted either prior to award of the contract or during performance of the contract is inaccurate, false or incomplete, shall constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of Lenoir County whether to terminate the contract for breach.

In determining whether a contractor has made Good Faith Efforts, the Town will evaluate all efforts made by the Contractor and will determine compliance in regard to quantity, intensity, and results of these efforts. Good Faith Efforts include:

1. Contacted minority businesses that reasonably could have been expected to submit a quote that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
2. Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
3. Broken down or combined elements of work into economically feasible units to facilitate minority participation.
4. Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in the recruitment of minority businesses.
5. Attended pre-bid meetings scheduled by the public owner.
6. Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
7. Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
8. Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
9. Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
10. Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.





**-- AFFIDAVIT B -- Intent to Perform Contract  
With Own Workforce**

County of \_\_\_\_\_

Affidavit of \_\_\_\_\_

(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the  
\_\_\_\_\_ Contract.

(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement.

The undersigned hereby certifies that he or she has read his certification and is authorized to bind the Bidder to the commitments herein contained.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_

(SEAL)

State of \_\_\_\_\_, County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_

Notary Public \_\_\_\_\_

My commission expires \_\_\_\_\_

**-- AFFIDAVIT C -- Portion of the Work to be  
Performed by Minority Firms**

County of \_\_\_\_\_

**(Note this form is to be submitted only by the apparent lowest responsible responsive bidder.)**

If the portion of the work to be executed by minority businesses as defined in GS 143-128.2(g) is equal to or greater than 10% of the bidder's total contract price, then bidder must complete this affidavit. This affidavit shall be provided by the apparent lowest responsible responsive bidder within **72 hours** after notification of being the low bidder.

Affidavit of \_\_\_\_\_ I do hereby certify that on the  
(Name of Bidder)

\_\_\_\_\_ (Project Name)

Project ID# \_\_\_\_\_ Amount of Bid \$ \_\_\_\_\_

I will expend a minimum of \_\_\_\_\_% of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. Attach additional sheets if required

Name and Phone Number	*Minority Category	Work Description	Dollar Value

\*Minority categories: Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Socially and Economically Disadvantaged (D)

Pursuant to GS 143 - 128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_

Signature: \_\_\_\_\_

SEAL

Title: \_\_\_\_\_

State of North Carolina, County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_

Notary Public \_\_\_\_\_

My commission expires \_\_\_\_\_

Do not submit with Bid      Do not submit with Bid      Do not submit with Bid      Do not submit with Bid

**-- AFFIDAVIT D -- Good Faith Efforts**

County of \_\_\_\_\_

**(Note this form is to be submitted only by the apparent lowest responsible responsive bidder.)**

If the goal of 10% participation by minority businesses is not achieved, this affidavit shall be provided by the apparent lowest responsible responsive bidder within **72 hours** after notification of being the low bidder.

Affidavit of \_\_\_\_\_  
(Name of Bidder)

I do certify the attached documentation as a true and accurate representation of my good faith efforts.  
Attach additional sheets if required

Name and Phone Number	*Minority Category	Work Description	Dollar Value

\*Minority categories: Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Socially and Economically Disadvantaged (D)

Documentation of the Bidder's good faith efforts to meet the goals set forth in these provisions.  
Examples of documentation include, but are not limited to the following evidence:

- A. Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- B. Copies of quotes or responses received from each firm responding to the solicitation.
- C. A telephone log of follow-up calls to each firm sent a solicitation.
- D. For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- E. Documentation of any contacts or correspondence to minority business, community or contractor organizations in an attempt to meet the goal.
- F. Copy of pre-bid roster.
- G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- H. Letter detailing reasons for rejection of minority business due to lack of qualification.
- I. Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_

State of North Carolina, County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_

Notary Public \_\_\_\_\_

SEAL

My commission expires \_\_\_\_\_

**MBE DOCUMENTATION FOR CONTRACT PAYMENTS**

Prime Contractor/Engineer/Architect: \_\_\_\_\_

Address & Phone: \_\_\_\_\_

Project Name: \_\_\_\_\_

Pay Application #: \_\_\_\_\_ Period: \_\_\_\_\_

The following is a list of payments to be made to minority business contractors on this project for the above mentioned period.

Firm Name	*Minority Category	Payment Amount	Owner Use Only

\*Minority categories: Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Socially and Economically Disadvantaged (D)

Date: \_\_\_\_\_

Approved/Certified By: \_\_\_\_\_  
Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Signature

**\*\*THIS DOCUMENT MUST BE SUBMITTED WITH EACH PAY REQUEST & FINAL PAYMENT\*\***

**-- END OF SECTION 00495 --**



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**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION****ARTICLE 1 GENERAL PROVISIONS****§ 1.1 BASIC DEFINITIONS****§ 1.1.1 THE CONTRACT DOCUMENTS**

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Project Manual, Pre-Bid Meeting Minutes, Specifications, Addenda issued prior to execution of the Contract, any other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order or a Change Proposal Request, (3) a Construction Change Directive or (4) a clarification, interpretation or a written order for a minor change in the Work issued by the Engineer/Architect. Each time the word "Architect" appears in the following pages, and it appears 406 times, the intention is that it reads "Engineer/Architect" as the Engineer is not a sub-consultant to the Architect on this project. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding requirements.

**§ 1.1.1.1 THE CONTRACTOR'S BID SHALL BE PART OF THE CONTRACT DOCUMENTS.****§ 1.1.2 THE CONTRACT**

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants or (4) between any persons or entities other than the Owner and the Contractor. The Architect and Owner shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Owner's and Architect's duties.

**§ 1.1.3 THE WORK**

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project. Work includes providing supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and functional installation even though not indicated in the Contract Documents

**§ 1.1.4 THE PROJECT**

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.

**§ 1.1.5 THE DRAWINGS**

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, diagrams, and notes, etc. Mechanical, Plumbing, and Electrical Drawings are diagrammatic only. Actual work shall be installed consistent with measurements obtained at the job-site, shall be coordinated with other trades as necessary, and shall be consistent with shop drawings, coordination drawings and manufacturer's published requirements.

**§ 1.1.6 THE SPECIFICATIONS**

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

**§ 1.1.7 THE PROJECT MANUAL**

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

The Project Manual is a volume assembled for the Work which may include the bidding requirements, sample forms, Conditions of the Contract and Specifications.

**§ 1.1.8 FURNISH:**

Unless specifically limited in context, the word “furnish” and any derivatives thereof, mean; furnishing to Project site items specified, materials, equipment apparatus, appurtenances, and all items necessary.

**§ 1.1.9 INSTALL:**

The word “install” and any derivatives thereof mean; incorporating in the Work including all necessary labor, materials, and connections to perform and properly complete in place, ready for operation or use, including unpacking and assembly if necessary.

**§ 1.1.10 PROVIDE:**

The word “provide” and any derivatives thereof mean; furnish and install as defined above.

**§ 1.1.11 THE CONTRACTOR SHALL:**

In interest of conciseness, sentences, statements, and clauses used may exclude any form of verb “shall” normally expressed in verb phrase with verbs such as “furnish”, “install”, “provide”, “perform”, “construct”, “erect”, “comply”, “apply”, “submit”, etc. Any such sentences, statements, and clauses are to be interpreted to include applicable form of phrase “the Contractor shall” and requirements described therein interpreted as mandatory elements of Contract.

**§ 1.1.12 EVALUATION:**

The word “evaluation” and any derivative thereof, as used in reference to Architect mean; to become generally familiar with the progress and quality of the portion of Work completed to determine in general if it is being performed in a manner indicating that the Work when completed may be occupied or utilized by the Owner for its intended use.

**§ 1.1.13 INSPECT:**

The word “inspect” and any derivative thereof, as used in reference to the Architect shall mean the type of evaluation that a reasonably prudent architect exercising ordinary professional skill and care on similar Projects would make to determine if the Work is in general accordance with the Contract Documents.

**§ 1.1.14 SEE:**

In interest of conciseness, references to specification sections and details are preceded by the word “see”. Any such references are to be interpreted to include applicable form of phrase “, and comply with”.

**§ 1.1.15 INDICATED and SHOWN:**

The word “indicated” or “shown” and any derivative thereof shall mean as detailed, scheduled, schematically depicted or stated in Contract Documents.

**§ 1.1.16 INSTRUMENTS OF SERVICE**

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect’s consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

**§ 1.1.17 INITIAL DECISION MAKER**

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 4.3 and certify termination of the Agreement under Section 14.2.2.

**§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS**

**§ 1.2.1** The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

required by one shall be as binding as if required by all; performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them. All work shall conform to the Contract Documents. No change there from shall be made without prior written authorization by the Owner. Where only part of the Work is indicated, similar parts shall be considered repetition. When any detail is shown and the components therefore are fully described, similar details shall be construed to require the same materials and construction. Whenever there are discrepancies between Drawings, or between the Drawings and Specifications, or conflicts within the Specifications, the Contractor shall furnish and install the better quality or greater quantity unless otherwise ordered in writing. Items required by either the Drawings or the Specifications and not mentioned in the other shall be of like effect as if shown or mentioned in both. Should the Specifications and Drawings fail to particularly describe a product or material shown to be used in any place, subject to the Architect's approval, the Contractor shall furnish the product that would normally be used in this place to produce first quality finished work.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed, nor to limit the scope of work performed by any trade or by any Subcontractor or supplier, unless the Work is indicated in the Instructions to Bidders to be accomplished under two or more prime contracts in lieu of a single prime contract. Such separations shall not operate to make the Architect an arbiter to establish limits of work between Subcontractors or between Contractor and Subcontractor.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 General Conditions of the Contract, and General Requirements apply to all specifications.

§ 1.2.5 References to "match existing" in Contract Documents refer to existing finishes, materials and qualities which have been used in adjacent portions of existing facilities.

§ 1.2.6 Material designations or details not specifically shown shall either match existing or be similar in finish, material or quality to similar adjacent conditions.

§ 1.2.7 Any inconsistency in the Contract Documents shall be resolved by giving precedence in the following order: (A) the Owner/Contractor Agreement, (B) the General Conditions, (C) Division 1 General Requirements, (D) the Drawings and Technical Specifications, and (E) the Bidding Documents consisting of the Notice to Bidders and Instructions to Bidders.

§ 1.2.8 Where items are specified by the use of a reference standard, the date of the reference standard shall be the latest edition published on the date the Agreement is executed unless a specific edition is referenced in the Specifications or in an applicable code, in which case the specific referenced edition shall govern.

§ 1.2.9 Materials which are shown on the drawings and which may not be specifically described in the Specifications or on the Drawings shall be furnished by the Contractor, shall be suitable for the intended use, and shall be subject to review for conformance with the intent of the Contract Documents. Where installation techniques are not specified, they shall be in accordance with the manufacturer's current instructions and industry standards.

**§ 1.3 CAPITALIZATION**

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION****§ 1.4 INTERPRETATION**

In the interest of brevity the Contract Documents frequently omit modifying words such as “all” and “any” and articles such as “the” and “an,” but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

**§1.5 EXECUTION OF CONTRACT DOCUMENTS**

**§1.5.1** The Contract Documents shall include and be enumerated on in or on attachment(s) to the Agreement, and any attachment(s) shall be signed by the Owner and Contractor.

**§1.5.2** Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

**§1.5.3** By executing the Contract, the Contractor represents he has reviewed all Contract Documents and the cost of all materials and equipment shown or indicated in the Contract Documents have been included in the Contract Sum and that all costs for materials and labor associated with the installation of such equipment have been included in the Contract Sum.

**§1.6 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE**

**§ 1.6.1** The Drawings, Specifications and other documents, including those in electronic form, prepared by the Architect and/or the Architect's consultants are Instruments of Service through which the Work to be executed by the Contractor is described. The Contractor may retain one record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect or the Architect's consultants, and unless otherwise indicated and any rights of the Owner, the Architect and/or the Architect's consultants shall be deemed the authors of them and will retain all common law, statutory and other reserved rights, in addition to the copyrights. All copies of Instruments of Service, except the Contractor's record set, shall be returned or suitably accounted for to the Architect, on request of the Owner or Architect, upon completion of the Work. The Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and/or the Architect's consultants. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and/or the Architect's consultants appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the Architect and/or the Architect's consultants. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' copyrights or other reserved rights.

**§ 1.6.1.1** If required to be furnished or if furnished, Architect or Architect's Consultants shall furnish electronic data in software format in use by Architect at the time Architect's services are performed. Contractor, any Subcontractors or Sub-subcontractors, material or equipment suppliers, or others shall be responsible for proper storage, maintenance and conversions necessary to prevent degradation or obsolescence of data. Any change or modification in electronic data by Contractor, any Subcontractors or Sub-subcontractors, material or equipment suppliers, or others shall be at their sole risk and without liability or legal exposure to Architect, Architect's consultants or Owner, and to fullest extent permitted by law, the Contractor, any Subcontractors or Sub-subcontractors, material or equipment suppliers agrees to hold harmless and indemnify Architect, Architect's consultants and Owner from and against all claims, liabilities, losses, damages, and costs, including but not limited to reasonable attorney's fees, arising there from or in connection therewith.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

§ 1.6.1.2 The Contractor, any Subcontractors or Sub-subcontractors, material or equipment suppliers, and others understands that the conversion of electronic information and data supplied by the Architect or Architect's consultants from the system and format used by the Architect or Architect's consultants to an alternative or upgraded system or format, whether performed by Architect, Architect's consultants or others, cannot be accomplished without the introduction of inexactitudes, anomalies, omissions and errors. In consideration of the Architect's agreement to deliver electronic data, the Contractor, any Subcontractors or Sub-subcontractors, material or equipment suppliers, and others agrees to hold Architect, Architect's consultants and Owner harmless and to waive any and all claims, liabilities, losses, damages, and costs arising out of or in any way connected with the conversion of electronic data supplied by the Architect or Architect's consultants.

§ 1.6.1.3 If documents, including those in electronic form, are modified, revised or changes in any way by the Contractor, Subcontractor, Sub-subcontractor, and material and equipment supplier, or others, any reference to the Architect and Architect's consultant, and any professional seals and signatures shall be removed from the documents.

§ 1.6.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

**§ 1.7 TRANSMISSION OF DATA IN DIGITAL FORM**

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

**ARTICLE 2 OWNER****§ 2.1 GENERAL**

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner may designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.1.1 Owner as referred to in these documents is: **Lenoir County, NC**

§ 2.1.2 The Owner shall furnish to the Contractor within thirty days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.1.3 Provided however, if required by the Owner's title insurer, lender or in connection with bond indebtedness, the Contractor shall execute a subordination agreement in form and substance satisfactory to such entities.

**§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER**

§ 2.2.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.



**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

§ 2.2.2 The Owner shall furnish surveys describing physical characteristics, legal limitations and known utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work. The Contractor shall be responsible for verification of exact utility locations. The accuracy of grades, elevations, dimensions or locations of existing conditions is not guaranteed by the Architect or Owner, and the Contractor is responsible for verifying such items.

§ 2.2.3 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness, and complete and accurate to the best of the Owner's information and belief. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.2.4 Contractor will be furnished, free of charge, one set of reproducible Drawings and one copy of the Project Manual which the Contractor may use for the limited purpose of making copies thereof required for use in performance of Work, in accordance with Paragraph 1.6.

**§ 2.3 OWNER'S RIGHT TO STOP THE WORK**

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

**§ 2.4 OWNER'S RIGHT TO CARRY OUT THE WORK**

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order or Construction Change Directive, shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

§ 2.4.1 Neither Owner nor its officers, agents, or employees are in any way liable or accountable to Contractor or its Surety, if any, for method by which completion of said work, or any portion thereof, is accomplished or for price paid therefore, unless Surety is required to pay cost to complete the Project, in excess of the amount contained in the Owner-Contractor Agreement, as a direct result of the Architect's negligent issuance of Certificate(s) for Payment. Contractor and Surety are responsible for all costs for completing the work including cost in excess of original contract price. Owner does not forfeit right to recover damages from Contractor or Surety for failure to complete contract by taking over the work or by declaring contract in default. Maintenance of the work remains Contractor's and Surety's responsibility as provided for in Performance Bond and guarantee of Contractor.

§ 2.4.2 The Owner reserves the right but not the obligation, to perform any work on the site, whether within or without the scope of the Contract, necessary to correct any conditions which at the sole discretion of the Owner pose a hazard to the health or safety of employees, visitors, or the general public. Such work will only be done on an emergency basis. If practical under the circumstances, the Contractor shall be given notice of any such conditions and given a reasonable opportunity to correct them. If work is done by the Owner pursuant to this paragraph which is necessitated by any act or failure to act of the Contractor, the costs associated with such work, including Owner's expenses and compensation for the

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

Architect's additional services and expenses, shall be deducted from any sums due the Contractor and a written Change Order or Construction Change Directive, adjusting the contract sum will be issued. If payments then or thereafter due to the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

**ARTICLE 3 CONTRACTOR****§ 3.1 GENERAL**

**§ 3.1.1** The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

**§ 3.1.2** The Contractor shall perform the Work in accordance with the Contract Documents.

**§ 3.1.3** The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

**§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR**

**§ 3.2.1** Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

**§ 3.2.2** Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a properly prepared, timely request for information (RFI) in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

**§ 3.2.3** Contractor's request for information, interpretation, or clarification shall be made to Architect in writing on Request For Information (RFI) form furnished by Architect. Contractor to submit completed copy of form completely filled out with request clearly stated. Reference all applicable drawings by detail and Specifications by section and paragraph. RFIs to be numbered sequentially (1, 2, 3, 4, etc.). Architect will return a single copy to Contractor. Contractor will copy and distribute to all parties affected by response.

**§ 3.2.4** Contractor accepts full responsibility for use of any information indicated in soil borings, test excavations and other subsurface investigations contained in reports provided in the bidding documents. The Contractor shall obtain at its own expense, any additional information necessary to perform the Work.

**§ 3.2.5** In event of inconsistency between portions of Contract Documents or within Contract Documents; Contractor shall provide better quality or greater quantity of Work, or comply with more stringent requirement, either or both in accordance with Architect's interpretation.

**§ 3.2.6** Contractor shall not make a claim, exceeding actual cost of work, if, in performing the Work, he finds actual subsurface conditions encountered which do not conform to those indicated by soil borings, test excavations, and other subsurface investigations.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

**§ 3.2.7** Contractor acknowledges that it has examined all documents pertaining to the Work, examined character of site and any existing structures, and has satisfied itself as to nature of the Work, and all other matters, which can in any way affect the Work.

**§ 3.2.8** The Contractor shall resolve all reported deficiencies with the Architect prior to awarding any subcontracts or starting any work with the Contractor's own employees. If any deficiencies cannot be resolved by the Contractor without additional time or additional expense, the Contractor shall so inform the Owner in writing. Any work performed prior to receipt of instructions from the Owner will be done at the Contractor's risk.

**§ 3.2.9** The Contractor shall be liable to the Owner or Architect for damage resulting from errors, inconsistencies or omissions in the Contract Documents the Contractor recognized or should have recognized and failed to report to the Architect. If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Architect, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

**§ 3.2.10** The following principles shall govern the settlement of disputes which may arise over discrepancies in the Contract Documents: (a) as between figures given on Drawings and the scaled measurements, the figures shall govern – no measurements shall be taken by scale as working dimensions except on large-scale Drawings not dimensioned in detail; (b) as between large-scale Drawings and small-scale Drawings, the larger scale shall govern; (c) as between Drawings and Specifications, requirements of the Specifications shall govern; and (d) as between the Agreement and the Specifications, requirements of the Agreement shall govern. The principles set forth herein shall not alter provisions of Article 1.2.

**§ 3.2.11** Any design errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect, but it is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents. The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations, unless they bear upon construction means, methods, techniques or safety and health precautions, but any nonconformity discovered by or made known to the Contractor shall be reported promptly to the Architect.

**§ 3.2.12** If Contractor fails to give such notice and, knowingly, proceeds with Work affected by errors or omissions in the Contract Documents, he shall correct any such errors, inconsistencies, or omissions at no additional cost to Architect and Owner.

**§ 3.2.13** If the Contractor believes that additional cost or time is involved because of clarifications, interpretations or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.11 the Contractor shall make Claims as provided in Section 4.3. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.11, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. The Contractor shall not be liable to the Owner or Architect for damages resulting from errors, or omissions in the Contract Documents or for differences between field measurements or conditions and the Contract Documents unless the Contractor should have recognized or recognized such error, , omission or difference and failed or knowingly failed to report it to the Architect.

**§ 3.2.14** In the event any error, inconsistencies, omission, or discrepancy in or between drawings and specifications exists or appears to exist, the Contractor shall not attempt to profit from such unintentional error, inconsistencies, omission, or discrepancy.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

**§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES**

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract.

§ 3.3.1.2 Any instructions that the Architect may issue to the Contractor shall be adjudged an interpretation of the requirements of the Contract Documents and not an act of supervision. The Architect has no authority and accepts no responsibility, either direct or implied, to direct and superintend the work.

§ 3.3.1.3 Coordination drawings: See Division 1.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.3.4 Contractor is solely responsible for coordination of scope of Work of Subcontractors and Suppliers, and to complete all Work, whether performed by the Contractor or a Subcontractor.

§ 3.3.5 The Contractor shall employ Licensed Surveyor to locate and stake out the Work and establish necessary reference and bench marks. Work from established bench marks and reference points, lay out and correctly establish all lines, levels, grades and locations of all parts of their own Work and be responsible for their accuracy and proper correlation with Work and established data.

**§ 3.4 LABOR AND MATERIALS**

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, air conditioning (heating and cooling), utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.1.1 Delivery, handling and storage of materials and equipment: See Division 1.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only if allowed by the Contract Documents and with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.2.1 Product options and substitutions after execution of contract: See Division 1.

§ 3.4.2.2 No substitutions of materials, products, or manufacturers will be considered under this Contract except under one or more of the following circumstances:

1. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
2. The specified product is unavailable through no fault of the Contractor.
3. The manufacturer or fabricator refuses to certify or guarantee the specified product as required.
4. Subsequent information reveals that the specified product is unable to perform properly or to fit in the designated space.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

**§ 3.4.3** The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

**§ 3.4.4** The Contractor shall insure that all product suppliers and Subcontractors, adhere to the Contract Documents and that they order products on time, taking into account the current market and delivery conditions, and that they provide products on time. The Contractor shall keep the Architect informed as to the availability of all specified materials and equipment and shall advise him promptly, in writing, of all material and equipment that may not be obtainable, or the availability of which may be delayed, whether due to conditions of the market or other limiting or governing factors beyond the Contractor's control.

**§ 3.5 WARRANTY**

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Owner or Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

**§ 3.5.1** Warranties and guarantees: See Division 1.

**§ 3.6 TAXES**

**§ 3.6.1** The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor which are legally enacted when Contractor's bids were received or negotiations between Owner and Contractor were concluded, whether or not yet effective or merely scheduled to go into effect. Contractor shall provide a sales tax report with each pay request, itemizing all state and local taxes paid for the period.

**§ 3.6.2** Contractor shall pay all sales, consumer, use and other similar taxes on all material and equipment not purchased directly by Owner, which are legally enacted at time bids are received, whether or not yet effective.

**§ 3.6.2.1** If the Contractor fails to submit a Sales Tax Report with each Application for Payment, the Owner will not pay such application until the required report is received by the Owner. Where no sales taxes have been paid for a particular month, a Sales Tax Report stating "No Taxes Paid" shall be submitted.

**§ 3.6.3** Contractor shall require all Subcontractors, Sub-subcontractors and suppliers to bill Contractor for all sales and use taxes on all materials and equipment incorporated into Project as clearly discernible separate item to facilitate Contractor's keeping tax as separate item of expense on records. Furnish the tax information on the Owner's Sales Tax Report form provided in the Contract Documents, in order to enable Owner to meet state reporting requirements.

**§ 3.7 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS**

**§ 3.7.1** The Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded. A copy of the building permit and heating/ventilating/air-conditioning, plumbing, electrical and other trade permits required for the Project shall be submitted to the Architect with or prior to the first Application for Payment.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.2.1 If the Contractor fails to give such notices, it shall be liable for and shall indemnify and hold harmless the Owner and the Architect, and their respective employees, officers and agents, against any resulting fines, penalties, judgments or damages, including reasonable attorney's fees, imposed on or incurred by the parties indemnified hereunder.

§ 3.7.2.2 The Contractor, his Subcontractors and all trades people working on the Project who are required by statute to be licensed shall have a current license in good standing before commencing any operations on the premises.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, without such notice to the Architect and Owner, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction, including any fines or other damages realized.

§ 3.7.4 Upon completion of the Work, the Contractor shall deliver to the Owner and Architect original copies of all required final certificates of inspection, the Certificate of Occupancy, and other documents evidencing that inspections required by authorities having jurisdiction over the Work have been performed.

**§ 3.8 ALLOWANCES**

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by Allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated Allowance amounts shall be included in the Allowances; and
- .3 whenever costs are more than or less than Allowances, the Contract Sum shall be adjusted accordingly by Change Order or Construction Change Directive. . The amount of the adjustment shall reflect (1) the difference between actual costs and the Allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner in sufficient time to avoid delay in the Work.

§ 3.8.4 The amount due the Contractor for any Allowance shall be based upon certified copies of invoices from suppliers and Subcontractors and shall not include any costs provided for in Paragraph 3.8.2.2.

§ 3.8.5 Allowances: See Division 1.

**§ 3.9 SUPERINTENDENT**

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding on the Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed on written request in each case. The Contractor's Project Manager and Superintendent shall be satisfactory to Owner and if requested in writing by Owner, shall be changed within 14 days.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review.

§ 3.9.3 The Contractor shall not change the superintendent without the prior written consent of the Owner, which consent shall not be unreasonable withheld. The superintendent shall be present at the Project until final completion. At the Owner's request, the Contractor shall assign a different superintendent to the Project.

§ 3.9.4 As directed by the Architect, there is to be held a regularly scheduled meeting of the representatives of the various trades engaged about the Work, for furthering the progress of the Work and giving of clarifications by the Architect. If the Contractor's representatives fail in attendance or in executing the instructions given them, they shall on request of the Owner be dismissed from the Work and other qualified representatives must be immediately substituted.

**§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES**

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall be revised at monthly intervals or as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work. The construction schedule shall not be changed without the written consent of the Owner and Architect.

§ 3.10.2 The Contractor shall prepare a submittal schedule after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.10.4 Construction schedules: See Division 1.

§ 3.10.5 Progress Reports: See Division 1.

§ 3.10.6 The Contractor shall furnish such manpower, materials, facilities and equipment and shall work such hours, including night shifts, overtime operations and Sundays and holidays, as may be necessary to insure the progress and completion of the Work in accordance with the approved and currently updated progress schedule. Should the Contractor fail to start any activity on the start date shown in the Contractor's Construction Schedule, or otherwise become delayed, he shall, without being entitled to any increase in the Contract Sum or other compensation, work overtime, increase his work force, or take such other actions as may be necessary or appropriate to complete the activity by the Completion Date shown on the Construction Schedule, or as such activity's completion date may have been adjusted by a revised Construction Schedule prepared to reflect an agreed-to extension of the Contract Time and incorporated into the Contract by an appropriate Change Order or Change Order Directive.

§ 3.10.7 The Architect may require the Contractor to submit, within seven calendar days following receipt of written notice, a recovery schedule demonstrating this program and the Contractor's proposed plan to make up the lag in scheduled progress and to insure completion of the Work within the Contract Time. If the Architect finds the proposed plan not acceptable, he may require the Contractor to submit a new plan.

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**§ 3.10.8** Failure of the Contractor to substantially comply with the requirements of this Paragraph 3.10 may be considered grounds for a determination that the Contractor is failing to execute the Work with sufficient diligence to ensure its completion with the Contract Time.

**§ 3.10.9** If the Contractor, without any fault on his part, is delayed in beginning any activity identified on the Progress Schedule he shall, nevertheless, have the same number of days as is shown in the Progress Schedule for the activity and the time for any succeeding activity that is dependent upon that activity shall be adjusted accordingly, provided that any time the Owner requires the Contractor to work overtime, to increase his forces, or to take any necessary or appropriate action to decrease the time required for any activity, the Contractor shall be entitled to an appropriate adjustment in the Contract Price.

**§ 3.10.10** The Contractor shall provide any and all information with respect to the progress of the Work and scheduling as the Owner may reasonably require.

**§ 3.10.11** If the completion of the Work or any milestone date is delayed by any fault, neglect, act or failure to act on the part of the Contractor, the Contractor shall in addition to all other obligations, and at no cost or expense to the Owner, take such actions, including but not limited to, increasing manpower, work such overtime may be necessary to make up for all time lost and to avoid delay in the progress and the completion of the Work.

**§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE**

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Owner upon completion of the Work.

**§ 3.11.1** Project record documents: See Division 1.

**§ 3.11.2** The Contractor shall record on the record copy of the Drawings maintained at the site all changes and selections made during construction and shall locate by dimensions showing actual field measurements of all major items which will be concealed in the completed work. These items shall include underground piping and conduit beneath slabs-on-grade (or basement slabs), underground site utilities such as pipe, conduit, etc.

**§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

**§ 3.12.1** Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

**§ 3.12.2** Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

**§ 3.12.3** Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged. Submit samples requiring color or finish selection in a single, coordinated submittal. The Architect will not approve color or finish schedule until he has received all samples and other data necessary for making complete color selections for the Project.

**§ 3.12.4** Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be



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so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

**§ 3.12.5** The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. The Contractor shall sign each submittal and stamp with, "REVIEWED FOR COMPLIANCE WITH THE CONTRACT DOCUMENTS AND APPROVED". Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect without action.

**§ 3.12.6** By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor and Subcontractor represents that the Contractor and Subcontractor has reviewed for compliance with the Contract Documents, and has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

**§ 3.12.7** The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect.

**§ 3.12.8** The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof.

**§ 3.12.9** The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such written notice, the Architect's approval of a resubmission shall not apply to such revisions.

**§ 3.12.10** The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

**§ 3.12.11** Submittals: See Division 1 for additional requirements.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION****§ 3.13 USE OF SITE**

The Contractor shall confine operations at the site to areas permitted by the Owner, applicable laws, statutes, ordinances, permits, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.13.1 Continued occupancy of existing facilities: See Division 1.

§ 3.13.2 Construction facilities, temporary controls and utilities: See Division 1.

**§ 3.14 CUTTING AND PATCHING**

§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.14.3 Cutting and patching: See Division 1.

§ 3.14.4 The Contractor is responsible for all cutting, patching, and finishing of walls, floors, roofs, etc., to allow demolition and installation of equipment, piping, ductwork, conduit, wiring, fixtures etc. within existing facilities. Any openings through existing concrete shall be core drilled. Prior to undertaking cutting or drilling operations the Contractor shall verify that no structural or other damage will be caused by the drilling process. Prior to all core drilling the trade Contractor shall make adequate provisions to protect areas from water damage and debris. Provide means to collect all water and debris or use a dry method acceptable to the Owner. No structural member shall be cut without prior written approval from the Architect. The Contractor shall employ acceptable (to the Owner) experienced installers to patch finishes.

**§ 3.15 CLEANING UP**

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents after reasonable notice from the Owner of such failure, the Owner may do so and the cost thereof shall be charged to the Contractor.

§ 3.15.3 Cleaning: See Division 1.

§ 3.15.4 Removal of debris and waste material shall be performed a minimum of one time daily and additionally as required to keep debris and waste from stockpiling and creating a potential fire or safety hazard.

**§ 3.16 ACCESS TO WORK**

The Contractor shall provide governmental authorities who may lawfully request access to the work, and the Owner and Architect proper facilities and equipment for access to the Work in preparation and progress wherever located.

§ 3.16.1 Emergency vehicle access to the existing facilities must be maintained at all times. Particular care

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shall be taken to minimize the off loading time of material delivery trucks. The Contractor shall provide a flagman with a radio to provide for immediate relocation of trucks in the event of an emergency.

**§ 3.16.2** The existing roofs shall be protected as required during the construction to prevent any damage and or leaks. The integrity of the roofing membrane shall be maintained on a daily basis. All cuts for work such as installing new assemblies shall be completely sealed each day.

**§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS**

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss (including but not limited to attorney's fees, court cost, and other costs of defense) on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright, trademark, trade name, or similar property right or interest, or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

**§ 3.18 INDEMNIFICATION**

**§ 3.18.1** To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them ("Indemnitees") from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 3.18.

**§ 3.18.2** In claims against any person or entity entitled to be indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

**§ 3.18.3** Contractor agrees to indemnify and hold Indemnitees harmless from any and all loss or damages, including reasonable attorney fees, arising out of any lien claims on the Project or its funds, jurisdictional labor disputes or other labor troubles of any kind that may occur during performance of Contract.

**§ 3.18.4** The purchase of insurance by the Contractor with respect to the obligations required herein shall in no event be construed as fulfillment of discharge of such obligations

**§ 3.18.5** None of the foregoing provisions shall deprive the Indemnitees, or the Contractor of any action, right or remedy otherwise available to them or any of them pursuant to the laws of the State in which the Project is located.

**§ 3.18.6** Notwithstanding any contrary provision herein or elsewhere in the Contract Documents, the Contractor shall not be obligated to indemnify and hold harmless any Indemnitee against liability for damages arising out of bodily injury to persons or damage to property, proximately caused by or resulting from the negligence, in whole or in part, of such Indemnitee, in violation of N.C.G.S 22B-1 or any amendment thereto. Any such provision shall be stricken and the remainder of such indemnification obligations shall remain in full force and effect.

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§ 3.18.7 The Contractor agrees to waive any right which it may have to assert an equitable lien against the Project funds, its real property and any improvements thereon.

**§ 3.19 PERSONS AUTHORIZED TO SIGN DOCUMENTS**

§ 3.19.1 The Contractor, prior to the execution of the Agreement between the Owner and Contractor shall file with the Architect a list of all persons in his firm who are authorized to sign documents such as contracts, certificates, and affidavits on behalf of the firm and to fully bind the firm to all the conditions and provisions of such documents, except that in the case of a corporation he shall file with the Architect a certified copy of a resolution of the Board of Directors of the corporation in which are listed the names and titles of corporation personnel who are authorized to sign documents on behalf of the corporation and to fully bind the corporation to all the conditions and provisions of such documents.

**ARTICLE 4 ARCHITECT****§ 4.1 GENERAL**

§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Architect" means the Architect or the Architect's authorized representative, or such representative as the Architect may designate, who may be employed by the Architect as a consultant.

§ 4.1.1.1 Each of these terms; "Architect", "Engineer", "Architect/Engineer", "A/E" or "Engineer/Architect" shall mean **Dunn & Dalton Architects, P.A.**, or an affiliate as otherwise provided in Contract Documents, or duly authorized representatives, such representatives acting severally within scope of particular duties entrusted to them, unless otherwise provided in Contract Documents.

§ 4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, and Architect. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a successor architect and whose status under the Contract Documents shall be that of the Architect.

**§ 4.2 ADMINISTRATION OF THE CONTRACT**

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents, and will be an Owner's representative (1) during construction, (2) until final payment is due and (3) with the Owner's concurrence, from time to time during the one-year period for correction of Work described in Paragraph 12.2. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with other provisions of the Contract; however, such authority shall not be considered or construed as creating a fiduciary relationship between the Architect and Owner.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of the Contractor's operations, or as otherwise agreed by Owner and Architect, and as Architect deems necessary (1) to become generally familiar with and to keep the Owner informed about the progress and aesthetic quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the Work, and (3) to determine in general if the Work is being performed in a manner indicating that the Work, when completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site evaluations or inspections to check the quality or quantity of the Work. The Architect will neither have control over or charge of, nor be responsible for, the construction means, methods, techniques, sequences or procedures, or for the safety or health precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Subparagraph 3.3.1.

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§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents or failure to complete work on schedule. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

**§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION**

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect, unless otherwise approved by the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner. Routine written communications between the Architect and the Contractor shall be in letter, memo, email or fax form. Such communications shall not be identified as "request for information", nor shall they substitute for any other written requirement pursuant to the provisions of the Contract Documents.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work. All costs made necessary by Contractor's failure to perform Work which conforms to the Contract Documents, including those of repeated procedures, shall be at Contractor's sole expense, including compensation for Architect's services and expenses.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. Such review and action on the part of the Architect is limited to only those submittals identified in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness as to cause no delay in the Work or in the activities of the Owner, Contractor or separate contractors, while allowing sufficient time in the Architect's professional judgment to permit adequate review by the Architect, Architect's consultants, and Owner, if needed. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect's review shall not constitute approval of safety or health precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's review or approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives or other change documents for changes in the Work for the Owner's approval and execution, and the Architect may authorize minor changes in the Work as provided in Section 7.4. The Architect will investigate and make

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determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

**§ 4.2.9** The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents as required by the Contract Documents and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment based upon the final inspection indicating the Work complies with the requirements of the Contract Documents, pursuant to Section 9.10.

**§ 4.2.10** If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such Project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

**§ 4.2.11** Project Representative may be employed at site by Architect. Project Representative's duties, responsibilities and limitations of authority are as set forth in an agreement between Owner and Architect, and will be provided upon request.

**§ 4.2.11.1** The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretations required of the Architect shall be furnished in compliance with this Paragraph 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretations until 21 days after receipt of written notice.

**§ 4.2.12** Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

**§ 4.2.13** Subject to the Owner's approval, the Architect's decisions on matters relating to aesthetic effect, will be final if consistent with the intent expressed in the Contract Documents.

**§ 4.2.13.1** The Architect will not undertake to settle differences between the Contractor, Subcontractors or suppliers or act as arbiter as to which Subcontractor, trade or supplier is to furnish or install various items indicated or required.

**§ 4.2.14** The Architect will review and respond to requests for information (RFI) about the Contract Documents. The Architect's response to such requests will be made in writing within seven days upon receipt. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

**§ 4.2.15** The Architect's response to a request for information (RFI), or issuance of a clarification or interpretation shall be considered an interpretation, clarification, supplemental information or an order for a minor change in the Work not involving an adjustment in Contract Sum or extension of Contract Time and not inconsistent with the intent of the Contract Documents, and shall be binding, unless indicated otherwise in the Architect's response to the RFI.

**§ 4.3 CLAIMS AND DISPUTES****§ 4.3.1 DEFINITIONS**

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the

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Owner and Contractor arising out of or relating to the Contract. Claims must be initiated by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

**§ 4.3.1.1 CLAIMS MUST CONTAIN FOLLOWING INFORMATION:**

- .1 Date of the event giving rise to such Claim and, if applicable, date when the event ceased;
- .2 Nature of occurrence or condition giving rise to the Claim;
- .3 Identification of contractual provisions affected, and a detailed explanation of how the Claim is contrary to those provisions;
- .4 An estimate of any change in the Contract Sum, including an itemized breakdown of additional cost, if any;
- .5 An estimate of the effect upon Project Schedule, including a comparison of Project Construction Schedule and schedules prepared in connection with the Claim. If required by Owner or Architect, this shall include showing in CPM format, both critical and non-critical path activities affected, and showing Project Construction Schedule and Claim sequences, durations and float substantiating delay claimed.

**§ 4.3.2 TIME LIMITS ON CLAIMS INITIATED PRIOR TO FINAL PAYMENT**

Claims by either party must be initiated and submitted within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Claims must be initiated by written Notice to the Architect and the other party.

**§ 4.3.3 CONTINUING CONTRACT PERFORMANCE**

Pending final resolution of a Claim except as otherwise agreed in writing or as provided in Subparagraph 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

**§ 4.3.4 CLAIMS FOR CONCEALED OR UNKNOWN CONDITIONS**

If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made and submitted within 21 days after the Architect has given notice of the decision. If the conditions encountered are materially different, the Contract Sum and Contract Time shall be equitably adjusted, but if the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect for initial determination, subject to further proceedings pursuant to Paragraph 4.4.

**§ 4.3.5 CLAIMS FOR ADDITIONAL COST**

If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Paragraph 10.4.

**§ 4.3.6** If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Architect, (2) an order by the Owner to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Architect, (4) failure of

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payment by the Owner, (5) termination of the Contract by the Owner, (6) Owner's suspension or (7) other reasonable grounds, Claim shall be filed in accordance with this Paragraph 4.3.

Notwithstanding anything to the contrary in the Contract Documents, an extension in the Contract Time, to the extent permitted under the Contract Documents shall be the sole remedy of the Contractor for any (1) delay in the commencement, prosecution or completion of the Work, (2) hindrance or obstruction in the performance of the Work, (3) loss of productivity, or (4) other similar claims (collectively referred to in this Paragraph as Delays) whether or not such Delays are foreseeable, unless a Delay is caused by acts of the Owner constituting active interference with the Contractor's performance of the Work, and only to the extent such acts continue after the Contractor furnishes the Owner with written notice of such interference. In no event shall the Contractor be entitled to any compensation or recovery of any damages, in connection with any Delay, including, without limitation, extended site conditions, consequential damages, lost opportunity costs, impact damages or other similar remuneration. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling or correction of the Work), regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be construed as active interference with the Contractor's performance of the Work.

**§ 4.3.7 CLAIMS FOR ADDITIONAL TIME**

If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

**§ 4.3.7.1** Only delay impacting the critical path of the Work shall be considered when determining if Contractor is entitled to additional time.

**§ 4.3.7.2** If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction and delay impacting the critical path of the Work..

**§ 4.3.8 CLAIMS FOR INJURY OR DAMAGE TO PERSON OR PROPERTY:**

If either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to evaluate the matter.

**§ 4.3.9 CLAIMS FOR ADJUSTMENTS TO UNIT PRICING**

If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

**§ 4.3.9.1** Unit Prices: See Division 1.

**§ 4.4 RESOLUTION OF CLAIMS AND DISPUTES**

Claims, including those alleging an error or omission by the Architect but excluding those arising under section 10.3, shall be referred initially to the Architect for decision. An initial decision by the Architect shall be required as a condition precedent to mediation, or litigation of all Claims between the Contractor and Owner arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Architect with no decision having been rendered by the Architect. The Architect will not decide disputes between the Contractor and persons or entities other than the Owner.



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§ 4.4.1 The Architect will review Claims and within ten days of the receipt of the Claim, take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Architect is unable to resolve the Claim if the Architect lacks sufficient information to evaluate the merits of the Claim or if the Architect concludes that, in the Architect's sole discretion, it would be inappropriate for the Architect to resolve the Claim.

§ 4.4.2 In evaluating Claims, the Architect may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Architect in rendering a decision. The Architect may request the Owner to authorize retention of such persons at the Owner's expense.

§ 4.4.3 If the Architect requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either provide a response on the requested supporting data, advise the Architect when the response or supporting data will be furnished or advise the Architect that no supporting data will be furnished. Within 21 days of receipt of the response or supporting data, if any, the Architect will either reject or approve the Claim in whole or in part.

§ 4.4.4 The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be final and binding on the parties but subject to mediation and arbitration, if allowed by this document.

§ 4.4.5 Upon receipt of a Claim against the Contractor or at any time thereafter, the Architect or the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Architect or the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 4.4.6 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines prior to a decision on the Claim by the Architect, prior to any required mediation or arbitration by the terms of this Contract.

**§ 4.5 DISPUTE RESOLUTION**

4.5.1 In the event of any dispute, claim, question or disagreement arising out of or relating to this Agreement or breach thereof, the parties hereto shall use their best effort to settle such matters by mutual agreement. To this effect, responsible, authorized representatives of the parties shall meet, consult and negotiate with each other in good faith, and, recognizing their mutual interests, attempt to reach a joint and equitable solution satisfactory to both parties. If they do not reach such solution within a period of thirty (30) days after the first notice by either party to the other of the existence of the dispute, and upon notice of either party to the other, the dispute shall be resolved by proceeding with the dispute resolution procedures set forth herein below.

- A. If the parties fail to agree on the resolution of any dispute through the negotiation process above, the parties shall proceed in good faith to attempt to settle the dispute through mediation by mediation either (1) under the Construction Industry Mediation Rules of the American Arbitration Association ("AAA") in accordance with its rules governing the mediation of such disputes or (2) any other procedure agreed upon by the parties. Any party who chooses to first refer the dispute to mediation may, in its notice to the other, elect to refer the matter to either the AAA or other agreed upon administrator of mediation. Mediation is a precondition to further dispute resolution by the parties, and the dispute resolution procedure set forth herein below shall only be available following a declaration of impasse by the mediator or by the mutual agreement of the parties.
- B. If impasse is declared in any mediated dispute, the matter shall be submitted to arbitration with the

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AAA under its Construction Industry Rules or such other arbitration procedure agreed upon by the parties. Notice of intent to seek arbitration of any unresolved dispute shall be given by the claiming party within ten (10) days of the declaration of impasse. The responding party shall select either AAA or other administrator agreed upon with the claiming party, within seven (7) days of the receipt of the notice of intent to arbitrate.

- C. The following additional rules and procedures shall apply to all disputes arising under this Agreement and shall be in addition to or, in the case of any conflict with, shall be in lieu of the applicable rules of the AAA or other agreed upon administration rules:
- (1) The parties acknowledge that this Agreement may evidence a transaction involving interstate commerce. Nonetheless, in rendering the award, the arbitrator(s) shall determine the rights and obligations of the parties according to substantive and procedural laws of the State of North Carolina, in general, and the North Carolina Revised Arbitration Act, in particular.
  - (2) All negotiations and mediation sessions and all arbitration hearings shall take place in Pitt County, North Carolina, or such other place as the parties may agree upon.
  - (3) In the arbitration of any dispute less than \$250,000, the sole arbitrator shall be a retired North Carolina or Federal Judge residing in the State of North Carolina. In disputes of \$250,000 or more, an arbitration panel of three (3) experienced construction industry professionals shall be appointed and shall include (a) one architect or engineer familiar with construction of health care facilities, (b) one experienced construction attorney or retired State of Federal Judge residing in the State of North Carolina, and (c) a senior staff representative of a public or private owner of a facility of the kind described in the Contract Documents.
  - (4) The Owner, the Contractor all Subcontractors, material suppliers, engineers, designers; architects, and their respective bonding companies and insurers and all other parties concerned with the construction of the improvements described in this Agreement are bound by this Dispute Resolution Clause to the greatest extent permitted by law, and all such parties consent and agree to the consolidation of all phases of the dispute resolution process hereunder with the dispute resolution proceedings pending among other parties whenever such proceeding arises out of the same transaction or are related to the same subject matter. The motion to consolidate may be made by any interested party and will be by an order of the arbitrator(s) petitioned, or if such arbitrator(s) fail to make such order, parties may apply to the Superior Court in Pitt County, North Carolina, for such order.
  - (5) At any time in the dispute resolution proceeding, the parties may agree to a high/low limitation which shall be binding upon all further proceedings.
  - (6) Discovery procedures may not be undertaken during negotiations or mediation phases. However, the parties shall proceed in good faith to make disclosure to the other party of all facts, documents, records and other evidence upon which each party bases its claim or defense.
  - (7) Prior to any arbitration hearing, limited discovery shall be permitted for the purpose of obtaining production of documents and taking depositions. All discovery shall be governed by the North Carolina Rules of Civil Procedure. All issues regarding conformation with discovery requests shall be decided by the arbitrator(s). Request for discovery shall be initiated within thirty (30) days after the notice of intent to arbitrate is given and shall be fully responded to within thirty (30) days after receipt. All discovery, including depositions, shall be completed within seventy-five (75) days of the notice of intent to arbitrate or within the time the arbitrator(s), upon motion by either party, may extend or reduce the time for

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discovery.

- (8) The arbitrators' award shall be in writing and upon the request of either party made prior to the initial hearing, shall include findings of fact and conclusions of law which support the award.
- (9) Either party may appeal the arbitration award to appellate arbitration by filing with the AAA or the agreed upon administrator, within twenty (20) days after transmittal of the award, a written brief, not to exceed twenty (20) pages, stating the reason why the arbitrator(s)' decision should be reversed or modified. The opposing party shall have twenty (20) days to file a responsive brief, not to exceed twenty (20) pages. An appellate arbitrator shall be appointed by the AAA or agreed upon administrator, and shall be a retired North Carolina Superior Court or Appellate Judge. Either party may request oral argument which must be concluded within fourteen (14) days following submission of the final brief. No additional evidentiary material may be introduced in the appellate arbitration. The appellate arbitrator shall render a written decision affirming, reversing, modifying or remanding the arbitrator(s)' decision within twenty (20) days after receiving the final appellate submission.

The appellate arbitrator may base its decision only on one of the following grounds:

- (a) Any ground specified in the Revised Uniform Arbitration Act Section 1-569.23;
- (b) A material error of applicable law by the arbitrator;
- (c) A determination that the award was partially wholly arbitrary or capricious.

The appellate arbitrator may render a final decision on appeal or may remand the matter for further proceeding by the arbitrator(s).

- (10) All fees and expenses of the mediation and of the arbitration procedures shall be borne by the parties equally. However, each party shall bear the expense of its own counsel, experts, witnesses, and preparation and presentation of proofs. Only in the case of extreme abuse of the procedure may the arbitrator(s) reallocate such costs and expenses among the parties.
- (11) The dispute resolution procedures set forth hereinabove shall be the exclusive remedies available to the parties to the Agreement to settle or resolve any and all disputes arising there under and any settlement or arbitral award may be enforced by an action in the Superior Court of Pitt County, North Carolina.

**ARTICLE 5 SUBCONTRACTORS****§ 5.1 DEFINITIONS**

**§ 5.1.1** A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

**§ 5.1.2** A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

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**§ 5.1.3** Architect is not required to, but shall be allowed to contact any Subcontractor, Sub-subcontractor, vendors or materials supplier when it is necessary for the Architect to obtain any form of input from these sources that the Architect may require for the completion of Architect's services on the Project. Requests for information, interpretation or clarification, and correspondence must all be in writing and must be routed through Contractor.

**§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK**

**§ 5.2.1** Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, within 15 days after award of the Contract, shall furnish in writing to the Owner and the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Owner and/or Architect will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Architect to reply promptly shall constitute notice of no reasonable objection.

**§ 5.2.2** The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

**§ 5.2.3** If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

**§ 5.2.4** The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

**§ 5.2.5** Acceptance of or failure to object to any or all listed Subcontractors or Sub-subcontractors by the Owner or Architect does not relieve Contractor from any responsibility for their failure to properly perform their work on the Project..

**§ 5.3 SUBCONTRACTUAL RELATIONS**

By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

**§ 5.3.1** Contractor is fully responsible for acts and omissions of Subcontractors, Sub-subcontractors and persons either directly or indirectly employed by them, or under their control, as Contractor is for its own employees.

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**§ 5.3.2** Nothing in Contract Documents creates any contractual relationship between any Subcontractor or Sub-subcontractor or other tiers, and Owner or Architect, except for provisions in paragraph 5.4.

**5.3.3** The Contractor shall assure the Owner, by written affidavit or in such other manner as the Owner may approve, that all agreements between the Contractor and his subcontractors incorporate the provisions of subparagraph 5.3 as necessary to preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the Work to be performed by Subcontractors so that the subcontracting thereof will not prejudice such rights.

**§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS**

**§ 5.4.1** Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract except to the extent the Owner has previously paid Contractor for a Subcontractor's work but Contractor failed to pay Subcontractor. In such event, if the Owner has required the Contractor to provide a Payment Bond and Subcontractor shall seek recovery of such past due amounts only from the Payment Bond Surety.

**§ 5.4.2** Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increased cost of mobilization resulting from the suspension.

**§ 5.4.2.1** Contractor will provide copies of its subcontracts, agreements and current information on status of its accounts, upon demand by Owner.

**§ 5.4.3** Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity including a completion contractor retained by the Surety.

**§ 5.5 ASSIGNMENT OF MATERIALS AND EQUIPMENT**

**§ 5.5.1** The Contractor accepts assignment of, and liability for, all purchase orders and other agreements for procurement of materials and equipment that are identified as part of the Contract Documents. The Contractor shall be responsible for such pre-purchased items, if any, as if the Contractor were the original purchaser. The Contract Sum includes, without limitation, all costs and expenses in connection with delivery, storage, insurance, installation and testing of items covered in any assigned purchase orders or agreements. All warranty and correction of the Work obligations under the Contract Documents shall also apply to any pre-purchased items, unless the Contract Documents specifically provide otherwise.

**ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS****§ 6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS**

**§ 6.1.1** Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site.

**§ 6.1.2** When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

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§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Work by others: See Division 1.

**§ 6.2 MUTUAL RESPONSIBILITY**

§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor to report shall constitute an acknowledgment that the Owner's or separate contractors completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor's, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor or others for which it is responsible, causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

**§ 6.3 OWNER'S RIGHT TO CLEAN UP**

If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises, jobsite, lay down and staging area and surrounding area free from waste materials and rubbish, the Owner may clean up after written notice, and the cost will be paid for by the Contractor.

**ARTICLE 7 CHANGES IN THE WORK****§ 7.1 GENERAL**

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Change Proposal Request, Construction Change Directive, clarification, interpretation or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order or Change Proposal Request shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; a clarification, interpretation or order for a minor change in the Work may be issued by the Architect alone.

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§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Change Proposal Request, Construction Change Directive, clarification, interpretation or order for a minor change in the Work.

**§ 7.2 CHANGE ORDERS**

§ 7.2.1 A Change Order or Change Proposal Request (CPR) is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 Methods used in determining adjustments to the Contract Sum are those listed in Subparagraph 7.3.3.

§ 7.2.3 Methods used in determining adjustments to Contract Time are subject to provisions in 4.3.7 and 7.5.6.

**§ 7.3 CONSTRUCTION CHANGE DIRECTIVES**

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect or Owner and signed by the Owner, directing a change in the Work, prior to any agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order or Change Proposal Request.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee;
- .4 As provided in Section 7.3.7, 7.5.4 and 7.5.5.or
- .5 Costs incurred by Owner due to the Contractor's failure to perform its obligations under the Contract.

§ 7.3.4 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.4.1 Failure of Contractor and Owner to agree on an adjustment of Contract Sum or Contract Time shall not excuse Contractor from proceeding with prosecution and performance of Work not affected by Construction Change Directive. Contractor and Subcontractors, Sub-subcontractors and Suppliers shall administer all disputes in a manner which will permit Work to proceed on schedule while the matter in dispute is being resolved.

§ 7.3.5 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

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**§ 7.3.6** If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit in accordance with subparagraph 7.5.4. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to those listed in subparagraph 7.5.4.

**§ 7.3.7** The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change. This pertains to costs associated with Change Orders, Change Proposal Request, Construction Change Directives, and Claims.

**§ 7.3.7.1** In determining the total cost or credit to the Owner resulting from a change in the Work, the allowances for overhead and profit combined, including the total cost to the Owner, shall not exceed the percentages herein scheduled, as follows:

- (1) For the General Contractor, for any work performed by his own forces, 10% of the direct cost;
- (2) For each Subcontractor involved, work performed by his own forces, 10% of the direct cost;
- (3) For the General Contractor, for work performed by his subcontractor, 5% of the amount due the subcontractor.

**§ 7.3.8** For any portion of such cost that remains in dispute, the Architect will make a determination. That determination of cost shall adjust the Contract Sum, subject to the right of either party to disagree and assert a claim in accordance with Article 4.

**§ 7.3.9** When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order or Change Proposal Request (CPR).

**§ 7.4 MINOR CHANGES IN THE WORK**

The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

**§ 7.5 CHANGE PROPOSAL REQUESTS**

**§ 7.5.1** Change Proposal Request (CPR) defines proposed changes in the Work, and is prepared and forwarded to Contractor by Architect.

**§ 7.5.2** Upon receipt of a Change Proposal Request, Contractor and Subcontractors shall review and evaluate the scope of the changes, and if any potential impact on Project is determined, shall notify Owner immediately. If there is a potential impact, the Owner may direct Contractor to stop Work in area affected by change to minimize the cost impact, or may direct Contractor, to proceed with the change.

**§ 7.5.3** Contractor shall submit proposal to Architect within 10 days after receipt of a Change Proposal Request, in such form as the Architect may prescribe, and an itemized accounting together with appropriate supporting data to substantiating adjustments in Contract Sum and/or Contract Time, if any.

**§ 7.5.4** All proposals shall be accompanied by a complete itemization and costs changes, including labor, materials, equipment and Subcontractors. Subcontractors and suppliers cost itemization shall also be provided. Method used to determine an adjustment in Contract Sum shall be limited to the following:



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- .1 Labor Wages: Itemized by each craft involved, indicating hourly rate for each and hours required excluding premium pay, paid to employees directly engaged in work. Rates shall be the actual rate paid the workman in accordance with established management labor agreements.
- .2 Labor Burden: Percent of actual wages for each craft includes: Mandatory fringe benefits required by established agreements, Vacation, Health and Welfare, Pension, Apprenticeship and other required programs, Social Security, and Unemployment Insurance.
- .3 Subsistence and/or Mileage: If in union agreements.
- .4 Materials and Equipment: Materials incorporated in Work at Contractor's actual invoice cost, including freight, and state sales tax. Indicate unit rates and units required
- .5 Overhead and Profit: 10 percent of net increase of labor and material for work performed by own forces. Includes, but not limited to: estimating; field supervision above foremen level superintendents, assistant superintendents, general foremen, engineers, accountants, timekeepers, office managers, and others on staff; office supplies; drinking water; temporary heat, temporary cooling, light and power; field toilets; small tools; record documents; and other cost of materials and/or equipment not incorporated in Work or directly associated with Work, including home office costs.
- .6 Directed Premium Time on Contract Work: Actual premium portion of wages for original contract Work which the Contractor was directed by Owner to be performed other than normal working hours, including; Social Security Taxes, Unemployment Insurance, and Union Fringe Benefits if required by Union Agreements, without overhead and profit mark-up.
- .7 Major Construction Equipment:
  - .7.1 Contractor Owned: Cost not to exceed 85 percent of current prevailing rates for rental of appropriate equipment for job and time period of use.
  - .7.2 Leased: Contractor's reasonable invoiced cost, (except lease-purchase Contractor equipment which is considered "Contractor owned").
- .8 Subcontractor Cost: Quoted in same manner prescribed for Contractor.
- .9 Overhead and Profit on Subcontractor's Work: 5 percent on net increase of Subcontractor's Work.
- .10 Bond and Insurance: Actual amount to be paid to surety and insurance carrier by Contractor without mark-up.

**§ 7.5.5** The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be net cost. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

**§ 7.5.6** Only delay impacting the critical path of the Work shall be considered when determining if Contractor is entitled to additional time. If proposals include a change in time, the Contractor shall substantiate the number of days. An estimate of cost and of probable effect of delay on the Work progress and Project schedule shall be included to substantiating potential delay, including a comparison of Project Construction Schedule and schedules prepared to substantiate a change in time, indicated in CPM format both critical and non-critical path activities affected, and show Project Construction Schedule and change sequences, durations and float.

**§ 7.5.7** Owner shall have the right within its sole discretion to require Contractor to commence performance of changes to Work based on Change Proposal Request prior to the submission by Contractor of cost proposal, or Owner's approval of the proposal. In such case, Contractor shall proceed with Work so changed upon receipt of a Construction Change Directive from Owner, and thereafter submit to Owner and Architect as soon as possible any cost proposal required for approval.

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§ 7.5.8 Construction Change Directive may be issued if change is to be made, but Contractor's proposal is not acceptable, or in order to expedite the change.

**§ 7.6 CONTRACTOR'S REQUEST FOR CHANGES**

§ 7.6.1 The Architect will review properly prepared, timely requests by the Contractor for changes in the Work, including adjustments to the Contract Sum or Contract Time. A request for a change in the Work shall be properly prepared, accompanied by the proposed cost, sufficient supporting data and information to permit the Architect to make a reasonable determination without extensive investigation to determine if the change is warranted or without the preparation of additional drawings or specifications. If the Architect determines that requested changes in the Work are not materially different from the requirements of the Contract Documents, the Architect may issue an order for a minor change in the Work or recommend to the Owner that the requested change be denied

§ 7.6.2 If the Architect determines that implementation of the requested changes would result in a material change to the Contract that may cause an adjustment in the Contract Time or Contract Sum, the Architect may make a recommendation to the Owner, who may authorize further investigation or issuance of such change. Architect may incorporate those changes into a Change Proposal Request for the Owner's consideration

**ARTICLE 8 TIME**

**§ 8.1 DEFINITIONS**

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract between the Owner and Contractor for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement or a written notice to proceed.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day.

**§ 8.2 PROGRESS AND COMPLETION**

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere or store materials or equipment on site prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance. Unless the date of commencement is established by the Contract Documents or a notice to proceed given by the Owner, the Contractor shall notify the Owner in writing not less than five days or other agreed period before commencing the Work to permit the timely filing of mortgages, mechanic's liens and other security interests.

§ 8.2.3 The Contractor shall begin the Work in accordance with subparagraph 8.2.2 and shall proceed diligently and expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time. Once the Work is begun, it shall proceed without interruption unless specific interruptions are included in latest Project schedule approved by the Owner. The Work shall be adequately and continuously manned by Contractor staff throughout the Contract Time.

§ 8.2.4 Contractor, Subcontractors and their Subsubcontractors shall complete and coordinate Work in accordance with established schedule.

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§ 8.2.5 Contractor is responsible for expediting Work, identifying potential conflicts and coordination problems, and proposing measures to avoid such problems.

§ 8.2.6 Whenever it becomes apparent that any activity completion date may not be met, Contractor shall take some or all of following actions and submit supplementary schedule indicating effect of action on progress and completion of Work, all without additional costs to Owner;

1. increase number of working hours per shift, shifts per working days, working days per week, or amount of construction equipment, or any combination of foregoing which will substantially eliminate backlog of Work, and put Project back on schedule, and/or,
2. increase construction manpower in such quantity as will substantially eliminate backlog of Work, and put Project back on schedule, and/or,
3. reschedule activities to achieve maximum practical concurrency of accomplishment of activities, and put Project back on schedule.

§ 8.2.7 If Contractor fails to take any of the actions indicated in subparagraph 8.2.6 within three (3) days after receiving written notice, Owner may take action to attempt to put Project back on schedule, and deduct cost of such actions from money due or to become due Contractor, or shall be grounds for determination by Owner that Contractor is not prosecuting Work with such diligence as will insure completion within Contract Time. Upon such determination, Owner may terminate Contractor's right to proceed with Work, or any separable part thereof, in accordance with provisions of Article 14.

§ 8.2.8 Contractor shall bear cost of any services of Architect made necessary by delays in completion of Work due to actions or inactions of Contractor or any Subcontractors. Contractor shall promptly pay any such cost upon demand by Owner. At Owner's option, these costs may be deducted from any amounts otherwise due Contractor.

**§ 8.3 DELAYS AND EXTENSIONS OF TIME**

§ 8.3.1 Completion time stipulated under other sections of the Contract Documents may be extended by Change Order or Construction Change Directive to provide one additional work day for each full work day that the Contractor is prevented from working by reason by one or more of the following causes which impact the critical path of the Project Schedule:

1. Unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not limited to, catastrophes and/or acts of God, acts of another Contractor in the performance of a separate contract with the Owner, epidemics, quarantine restrictions, strikes or freight embargoes;
2. An unusual amount of severe weather to such an extent as to be definitely abnormal and beyond conditions that may be reasonably anticipated. For the purpose of this contract, a minimum of three (3) working days per calendar month shall be anticipated as "normally bad or severe weather", and such time will not be considered justification for an extension of time.
3. Stoppage of work ordered by the Owner for reasons over which Contractor has no control.

§ 8.3.2 No claims for extension of time will be considered when based on delays caused by conditions existing at the time bids were received, and of which the Contractor might reasonably expect to have full knowledge at the time of bidding, or upon delays caused by failure on the part of the Contractor to anticipate properly the requirements of the work contracted for as to materials, labor, and equipment. All claims for extension of time shall be made in writing to the Architect with or prior to the next application for payment; otherwise they shall be waived.

§ 8.3.3 Completion date stipulated under other sections of Contract Documents may be extended by Change Order to compensate for additional work that may be ordered by Owner, provided such work is over and beyond the current scope of work Contractor, and is of such nature as to materially affect date of completion.

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**§ 8.3.4** Time extensions, when approved, will be granted with the understanding and agreement by all parties that no charges, beyond those approved at the time of the occurrence of the event causing the extension, will be assessed the Owner for overhead and profit by the Contractor. Belated extended overhead charges will not be considered.

**ARTICLE 9 PAYMENTS AND COMPLETION****§ 9.1 CONTRACT SUM**

The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

**§ 9.2 SCHEDULE OF VALUES**

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

**§ 9.2.1** Application for Payments and Schedule of Values: See Division 1 for additional schedule of value requirements.

**§ 9.3 APPLICATIONS FOR PAYMENT**

**§ 9.3.1** Unless otherwise provided in the Contract documents: At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the schedule of values. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents

**§ 9.3.1.1** Such applications may not include requests for payment for portions of Work for which the Contractor does not intend to pay to a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

**§ 9.3.1.2** The Contractor's Applications for Payment shall be made on AIA Form G-702 and the certification included thereon shall be executed and notarized. All pay applications shall be submitted with Contractor's daily "Project Monitoring Logs" for the days corresponding with the period for which application for payment is made.

**§ 9.3.2** Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

**§ 9.3.3** The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

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**§ 9.3.4** Application for Payments and Schedule of Values: See Division 1 for additional Application for Payment requirements.

**§ 9.4 CERTIFICATES FOR PAYMENT**

**§ 9.4.1** The Architect will, within seven days after receipt of the Contractor's Application for Payment and the Architect's site visit, either issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Subparagraph 9.5.1.

**§ 9.4.2** The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Architect's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site evaluations or inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

**§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION**

**§ 9.5.1** The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a separate contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents; or
- .8 failure to comply with the approved Project construction schedule;
- .9 erroneous estimates by the Contractor of the value of the work performed; or
- .10 the existence of any event of default under the Contract Documents.

**§ 9.5.2** When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION****§ 9.6 PROGRESS PAYMENTS**

**§ 9.6.1** Progress (monthly) payments will be made on account of 90 percent (90%) of the work done plus 90 percent (90%) of the material stored or stockpiled in an approved manner and location. However, when the value of completed work (excluding stored materials) reaches 50 percent (50%) or more of the current contract amount and provided satisfactory progress is being maintained on the Project, the Architect, upon request from Contractor with written consent of surety, may recommend to the Owner that the retainage be reduced to 5 percent (5%) of the value of work completed and materials stored on site. However, if the Contractor is granted the privilege of reduced retainage and thereafter falls behind for two successive months in his construction progress schedule, the original provisions for retainage shall automatically become effective the third month.

**§ 9.6.1.1** Owner will make monthly partial payments to Contractor within 25 days after receipt of Certificate for Payment from Architect.

**§ 9.6.1.2** Owner may withhold payment to Contractor notwithstanding Architect's certification, if it is necessary, in Owner's opinion, to do so to protect Owner from loss due to any of the reasons set forth in Subparagraphs 9.5.1.1 to 9.5.1.10, inclusive.

**§ 9.6.2** The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of such Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

**§ 9.6.3** The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect on account of portions of the Work done by such Subcontractor.

**§ 9.6.4** Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor except as may otherwise be required by law.

**§ 9.6.5** Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

**§ 9.6.6** A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

**§ 9.6.7** Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

**§ 9.7 FAILURE OF PAYMENT**

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Architect or awarded by mediation, then the Contractor may, upon seven additional days' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of

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the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

**§ 9.8 SUBSTANTIAL COMPLETION**

**§ 9.8.1** Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The Work or designated portion thereof will not be considered to have achieved Substantial Completion until all systems are operational as designed; all life-safety components of the Work are complete; all designated or required governmental inspections or certifications have been made and posted including those by the State Division of Health and Human Services (DHSR), designated instructions of Owner's personnel in the operation of systems has been completed; and all final finishes are in place. The Owner's occupancy or use of the Work or a designated portion thereof under the provisions of Paragraph 9.9 shall in no way constitute the acceptance of the Work as Substantially Complete until the provisions of this Subparagraph 9.8.1 have been satisfied.

**§ 9.8.2** Unless otherwise provided in the Contract Documents: When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall thoroughly inspect the work, and prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment and a written request for Architect's review of the work. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

**§ 9.8.3** Unless otherwise provided in the Contract Documents: After receipt of the Contractor's Notice of Substantial Completion and the Contractor's list, the Architect and Owner will make inspections to determine whether the Work or designated portion thereof is substantially complete. If the Architect's and Owner's inspections discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit another Contractor's Notice of Substantial Completion and a request for another inspection by the Architect to determine Substantial Completion.

**§ 9.8.3.1** The Contractor's list shall include the following items; a) Request for Architect's Substantial Completion Inspection; b) Reports of the Contractor's inspections of every interior, exterior, and site element; c) Reports of all tests evidencing satisfactory function of every operable system as required; d) Reports on the instruction of the Owner's personnel in the use of operable systems and equipment including maintenance and operating information; e) Acceptance by each regulatory body having jurisdiction, including but not limited to NC Department of Health and Human Services, Division of Health Service Regulation; f) Certificate of Occupancy; g) List of items to be completed or corrected for each interior, exterior and site element, including operable systems and equipment; h) Operations and Maintenance Manuals; i) Test and Balance Reports; and j) All warranties.

**§ 9.8.3.2** In the event that more than the two inspections by the Architect, described above are made necessary by the failure of the Contractor to complete the Work or to complete or correct items identified on the list of such items, the Contractor shall reimburse the Owner for all costs incurred including the cost of the Architect's services made necessary thereby.

**§ 9.8.3.3** If the Contractor requests that the Architect prepare a list prior to Substantial Completion, or should the Contractor request a list be prepared to assist the Contractor in his completion and corrective work, or should the Architect be caused additional expense because of the Contractor's claim that work has been completed or corrected when it has not, then the Contractor shall reimburse the Owner for all additional costs incurred from the Architect for services provided by such request. The costs of such services will be withheld from payments then or thereafter due to the Contractor.

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§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.8.6 Contract Closeout: See Division 1 for additional Substantial Completion requirements.

**§ 9.9 PARTIAL OCCUPANCY OR USE**

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.6 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete or the Owner notifies the Contractor of intent to occupy or use a portion of the work prior to substantial completion, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

**§ 9.10 FINAL COMPLETION AND FINAL PAYMENT**

§ 9.10.1 Unless otherwise provided in the Contract Documents: The Contractor shall inspect the work to determine that it is complete, is in accordance with the Contract Documents, and the Contract is fully performed. Upon receipt of the Contractor's Notice of Final Completion certifying that the Work is complete, is in accordance with the Contract Documents, that the Contract is fully performed,, that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect and Owner will in a reasonable time make such inspection and, when the Architect and Owner finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's and Owner's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.



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**§ 9.10.2** Unless otherwise provided in the Contract Documents: Neither a progress payment nor a final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in the forms designated by the Owner, and attached hereto as Exhibits 1A thru 1D. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

**§ 9.10.2.2** The Contractor shall submit closeout documents in accordance with Division 1 – General Requirements, prior to submitting final Application for Payment.

**§ 9.10.3** If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

**§ 9.10.3.1** Final payment constituting entire unpaid balance of Contract Amount will be paid by Owner to Contractor within thirty (30) days after final Certificate for Payment has been issued by Architect.

**§ 9.10.4** The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents, or
- .4 faulty or defective Work appearing at or after final completion.

**§ 9.10.5** Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

**§ 9.10.5.1** Contract Closeout: See Division 1 for additional Final Completion and Final Payment requirements.

**ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY****§ 10.1 SAFETY AND HEALTH PRECAUTIONS AND PROGRAMS**

The Contractor shall be responsible for initiating, maintaining and supervising all safety and health precautions and programs in connection with the performance of the Contract. This requirement applies continuously and is not limited to normal working hours.

**§ 10.1.1** The Architect's site responsibilities are limited solely to the activities of the Architect and the

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Architect's employees on site. These responsibilities shall not be inferred by any party to mean that the Architect has responsibility for site safety. Safety in, on, or about the site is the sole and exclusive responsibility of the Contractor alone. The Contractor's methods of work performance, superintendence of the Contractor's employees, and sequencing of construction are also the sole and exclusive responsibility of the Contractor alone.

**§ 10.1.2** The Contractor agrees to waive any claim against the Owner and Owner's agents, architects, engineers, consultants, and their employees acting within the scope of their duties, and to defend, indemnify, and hold them harmless from any claim or liability for injury or loss that allegedly arises from the Contractor's performance of the Work described herein. The Contractor shall require all Subcontractors to conform with this provision before they start any work. Contractor shall insure this provision is in conformity with the insurance provision of this Contract.

**§ 10.2 SAFETY AND HEALTH OF PERSONS AND PROPERTY**

**§ 10.2.1** The Contractor shall take precautions for safety and health of, and shall provide protection to prevent damage, injury or loss to

- .1 employees on the Work and other persons who may be affected thereby, to include but not limited to the Owner and Architect, and their consultants and employees;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

**§ 10.2.2** The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety and health of persons or property or their protection from damage, injury or loss.

**§ 10.2.3** The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety, health and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying Owners and users of adjacent sites and utilities.

**§ 10.2.4** When use or storage of hazardous materials or equipment or unusual methods are necessary for execution of the Work, such as driving or removal of piles, wrecking, demolition, excavation or other similar potentially dangerous work is necessary, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel and shall give Owner reasonable advance notice. Contractor is fully responsible for any and all damages, claims, and for the defense of all actions against Owner and Architect, and their consultants and employees resulting from the prosecution of such work.

**§ 10.2.4.1** Use or storage of explosives is prohibited.

**§ 10.2.5** The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

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§ 10.2.6 The Contractor shall designate a responsible, properly trained and qualified member or members of the Contractor's organization at the site whose duties shall be the prevention of accidents, damage to property, and to supervise and train personnel in the use of dangerous and hazardous equipment, materials and substances necessary for execution of the work. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not load or permit any part of the construction or site, including new construction or existing facilities to be loaded with weights that will exceed design loads so as to endanger safety of persons or property.

§ 10.2.8 Contractor shall give notice in writing at least 48 hours before breaking ground, to all persons having interests on or near site, Public Utility Companies, Owners of property having structures or improvements in proximity to site of the Work, agencies, authorities, inspectors, or those otherwise in charge of property, streets, water pipes, gas pipes, sewer pipes, telephone cables, electric cables, railroads or otherwise who may be affected by Contractor's operation, in order that they may remove any obstruction for which they are responsible and have representative on site to see that their property is properly protected. Such notice does not relieve Contractor of responsibility for any damages, claims, and defense of all actions against Owner and Architect resulting from performance of such Work in connection with or arising out of Contract.

§ 10.2.9 All parts of Work shall be braced to resist wind or other loads. Contractor shall perform Work with the explicit understanding that the design of the Project is based on all parts of Work having been completed and as such, the methods of performance of each part of Work shall be done accordingly.

§ 10.2.10 Temporary items such as, but not limited to scaffolding, staging, lifting and hoisting devices, shoring, excavation, barricades, and safety and construction procedures necessary in completion of Project shall be the responsibility of the Contractor and its Subcontractors and shall comply with all applicable codes and regulations. It shall not be responsibility of Owner, Architect or their representatives to determine if Contractor, Subcontractors or their representatives are in compliance with the aforementioned regulations.

§ 10.2.11 The Contractor shall comply with all Federal Occupational Safety and Health Administration Hazard Communications Act (HAZCOM) requirements, including properly maintaining Materials Safety Data Sheets (MSDS) at the Project site. The Contractor shall ensure that all MSDS are compiled in a single location at the Project site, and are available to the regulating agencies. The Contractor shall indemnify and hold the Owner and Architect harmless for their respective failure to comply with this provision.

§ 10.2.12 The Contractor shall be responsible for any fines, penalties or charges by any regulatory body by reason of any violation of safety or health regulations. Contractor shall also be responsible for reimbursement of any OSHA fines incurred by the Architect for Project site safety conditions created or controlled by the Contractor, that result in the Architect receiving a citation under the OSHA multi-employer citation provision.

§ 10.2.13 The Contractor shall notify Owner's and Architect's personnel upon arrival to the Project site of any known safety or health hazards at the Project, and the precautions they should take.

§ 10.2.14 The Contractor shall provide safety and health equipment (excluding boots) for the Owner and Architect to protect them from safety and health risks during the performance of their services during the construction of the Project.

§ 10.2.15 The Architect's review of Contractor's performance does not include review of adequacy of Contractor's safety or health measures.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION****§ 10.3 HAZARDOUS MATERIALS OR SUBSTANCES**

**§ 10.3.1** The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a hazardous material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner in writing, with a copy to the Architect.

**§ 10.3.1.1** The term "hazardous materials or substance" also includes, but is not limited to asbestos, asbestos products, polychlorinated biphenyl (PCB), radon gas, industrial waste, acids, lead, alkaline, irritants, contaminants, or other pollutants, excluding mild chemicals used in the cleaning of finished building materials.

**§ 10.3.2** The Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If the Contractor has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor has no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. The Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up, which adjustments shall be accomplished as provided in Article 7.

**§ 10.3.2.1** The Work in the affected area shall be resumed immediately following the occurrence of any one of the following events: (1) the Owner causes remedial work to be performed which results in the absence of asbestos, polychlorinated biphenyl (PCB) or other hazardous materials or (2) the Owner and the Contractor, by written agreement, decide to resume performance of the Work, or (3) an appropriate governmental authority or environmental engineer certifies in writing that the Work may safely and lawfully proceed. In no event shall the Owner have any responsibility for any substance or material that is brought to the Project site by the Contractor, any subcontractor, any materialmen or supplier or any entity for whom any of them is responsible. The Contractor agrees not to use fill, products or other materials to be incorporated into the Work which may contain any asbestos, polychlorinated biphenyl (PCB) or other hazardous materials.

**§ 10.3.3** The Architect and Architect's consultants and employees shall have no responsibility for the discovery, presence, handling, removal or disposal of or exposure of persons to hazardous materials or toxic substances in any form at the Project site.

**§ 10.3.4** The Owner and Architect shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the Project site unless such materials or substances are required by the Contract Documents and the Contractor so notified the Owner and Architect. The Contractor shall notify the Owner and Architect prior to bringing any hazardous material or substance on to the Project site.

**§ 10.3.5** If, without negligence on the part of the Contractor, the Contractor is held liable for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

**§ 10.4 EMERGENCIES**

In an emergency affecting safety or health of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension

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of time claimed by the Contractor on account of an emergency shall be determined as provided in paragraph 4.3 and Article 7.

**§ 10.4.1** The Contractor shall promptly report in writing to Owner and Architect all accidents arising out of or in connection with the performance of the Work, whether on or off the site, which caused death, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or serious property damages are caused, the accident shall be reported immediately by telephone or messenger to Owner and Architect.

**ARTICLE 11 INSURANCE AND BONDS****§ 11.1 CONTRACTOR'S LIABILITY INSURANCE**

**§ 11.1.1** The Contractor shall purchase and maintain in companies properly licensed to do business in the state in which the Project is located and acceptable to the Owner, such insurance as will protect him, the Owner, the Architect and their agents, representatives, and employees from claims set forth below which may arise out of or result from the Contractor's operations under the Contract, whether such operations be by himself or by any Subcontractor or Subsubcontractor by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

1. claims under workers' or workmen's compensation, disability benefit and other similar employee benefit acts (with Workmen's Compensation and Employer's Liability Insurance in amounts not less than those necessary to meet the statutory requirements of the state(s) having jurisdiction over any portion of the Work);
2. claims for damages because of bodily injury, sickness or disease, or death of his employees; the Contractor will require his Subcontractors to similarly provide Workmen's Compensation Insurance for all of the latter's employees.
3. claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees;
4. claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by any other person;
5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting there from;
6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle; and
7. claims for bodily injury or property damage arising out of completed operations.
8. Claims for losses, including bodily injury and property damage, covered by a Commercial General Liability policy.

The insurance shall be primary and noncontributing to any insurance possessed or procured by the Owner, and limits of liability shall be not less than those set forth herein or required by law, whichever is greater.

The insurance required shall have coverage limits of not less than the following:

Worker's Compensation including Occupational Disease and Employer's Insurance:

- a. Statutory – Amounts and coverage as required by Law including any applicable provision for Voluntary Worker's Compensation benefits as required by Labor Union agreements and including the "All States" endorsement.
- b. Employers Liability – At least \$100,000 each accident.

Public Liability and Property Damage Insurance – The Contractor shall provide and maintain, during the life of the contract, Comprehensive General Liability Insurance, including coverage for Premises Operations, Independent Contractors, Completed Operations, Products and Contractual Exposures, as shall protect such Contractors from claims arising out of any bodily injury, including accidental death, as

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well as from claims for property damages which may arise from operations under this contract, whether such operations be by the Contractor or by any subcontractor, or by anyone directly or indirectly employed by either of them and the combined single limit of such insurance shall be \$3,000,000.

Such coverage for completed operations must be maintained for at least two (2) years following final acceptance of the work performed under the contract.

Property Damages, including broad Form Property Damage and Explosion, Collapse, Underground property damage coverage, and blasting, where necessary.

Completed Operations Liability: Continuous coverage in force for one year after completion of Work.

Comprehensive Automobile Liability Insurance, including coverage for owned, non-owned and hired vehicles:

- a. Bodily Injury Liability - \$1,000,000 for each person and \$1,000,000 for each accident.
- b. Property Damage Liability - \$1,000,000 for each accident and \$3,000,000 for the aggregate of operations.

**§ 11.1.2** In addition to Contractual Liability including indemnification provision, Bodily Injury and Property Damage coverage under both comprehensive General and Comprehensive Automobile forms shall include "occurrence" basis wording, which means an event, or continuous or repeated exposure to condition which unexpectedly causes injury or damage during policy period.

**§ 11.1.3** Contractor shall either (a) require each of its Subcontractors to procure and maintain during the life of its subcontract, Subcontractor Comprehensive General Liability, Automobile Liability, and Property Damage Liability Insurance of the type and in the same amounts as specified in this Subparagraph, or (b) insure the activities of its Subcontractors in its own policy.

**§ 11.1.4** The insurance required by subparagraph 11.1.1 shall include contractual liability insurance applicable to the Contractor's obligations under Paragraph 3.18.

**§ 11.1.5** Certification of Insurance must be filed through the Architect by an insurer authorized to do business in the State in which the Project is located. All blanks and questions on Certificate must be filled out completely. Incomplete or inadequate Certificate will be returned to Contractor as unsatisfactory and commencement of its work will be delayed until satisfactory Certificate is submitted. Such delay will not warrant extension of contract time. These certificates shall contain a provision that coverage afforded under the policies will not be canceled until at least thirty days prior written notice has been given to the Owner.

**§ 11.1.6** If excavation is required, Contractor shall obtain underground hazard coverage in addition to those shown above.

**§ 11.1.7** If this insurance is written on Comprehensive General Liability policy form shall be AIA Document G705, Certificate of Insurance. If this insurance is written on a Commercial General Liability policy form, AIA Document G715 for ACCORD form 25S may be acceptable.

**§ 11.2 OWNER'S LIABILITY INSURANCE**

The Contractor shall be responsible for purchasing and maintaining complete Owner's protective liability insurance covering claims which may arise from operations under the Contract. The Contractor shall file a copy of all Owners' protective liability insurance policies with the Owner before any exposure to loss may occur. Limits shall be the same as specified for general liability and property damage insurance.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION****§ 11.3 PROPERTY INSURANCE**

**§ 11.3.1** The Owner shall be responsible for purchasing and maintaining Builders Risk property coverage upon the entire work at the site to the full insurable value thereof. Applicable deductibles shall be borne by the Owner. Owner will not be responsible for insuring any tools owned by mechanics, equipment, scaffolding, staging, towers and forms owned or rented by the Contractor, which are not intended to become part of the Project. The interest of the Contractor, subcontractors and sub-subcontractors in this insurance, if any, shall only be effective during the construction of the Project and all rights and interests of the Contractor, subcontractors and sub-subcontractors, if any, in this insurance shall end upon acceptance of the Project by the Owner.

**§ 11.3.2** Any insured loss is to be adjusted with the Owner and made payable to the Owner as trustee for the insured's, as their interests may appear, subject to the requirements of any applicable mortgage clause.

**§ 11.3.3** The Owner shall file a certificate of all policies with the Contractor before an exposure to loss may occur. If the Owner does not intend to purchase such insurance, he shall inform the Contractor in writing prior to commencement of the work. The Contractor then shall effect insurance which shall protect the interest of himself, its Subcontractors and the Sub-subcontractors in the work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure of the Owner to purchase or maintain such insurance and so notifies the Owner, then the Owner shall bear all reasonable cost appropriately attributable thereto.

**§ 11.3.4** The Subcontractors or Sub-subcontractors and the Contractor shall remedy any defects due to such faulty materials or workmanship and pay for any damage to other Work resulting therefrom, which shall appear within a period of one year from the date of acceptance as defined in general conditions, and in accordance with the terms of any special guarantee provided in the Contract. The Owner shall give notice of observed defect within ninety (90) days of the time that they were observed or should have been observed.

**§ 11.3.5** The Owner as trustee shall have the power to adjust and settle with the insurers.

**§ 11.3.6** If the Owner finds it necessary to occupy or use a portion or portions of the work prior to substantial completion thereof, such occupancy shall not commence prior to a time mutually agreed to by the Owner and Contractor, which agreement shall not be unreasonably withheld, and before the consent of the insurance company or companies providing the property insurance. This insurance shall not be canceled or lapsed on account of such partial occupancy or use.

**§ 11.3.7** Any wall or steel construction during this period of coverage must be properly braced, regardless of plans or specifications otherwise, to prevent damage from wind.

**§ 11.4 PERFORMANCE BOND AND PAYMENT BOND**

**§ 11.4.1** The Contractor shall, prior to signing the Contract, furnish bonds covering the faithful performance of the Contract and the Payment of all obligations arising there under. Cost of Bonds shall be paid by the Contractor.

**§ 11.4.2** The Contractor shall deliver the bonds to the Owner not later than the date of execution of the Contract, or if the Work is commenced prior thereto in response to a Notice to Proceed, the Contractor shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such Bonds will be issued.

**§ 11.4.3** Amount shown on each bond shall be equal to 100 percent of the total amount payable by terms of the Contract. Surety shall be a company licensed to do business in the State in which the work is located and shall be acceptable to Owner. The surety shall have an "A" minimum rating of performance as stated in the most current publication of Best's Key Rating Guide, "Property Liability" which shall show a financial strength rating of a least five (5) times the Contract Price. Each bond shall be accompanied by a

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"Power of Attorney" authorizing the attorney-in-fact to bind the surety and certified to include the date of the Bond.

§ 11.4.4 Bonds shall be dated the same as or subsequent to the Contract, and accompanied by a current Power of Attorney. Bonds shall be furnished in sufficient number of copies so that one copy can be bound with each copy of the Agreement.

§ 11.4.5 Contractor shall keep Surety informed of progress of Work, and, where necessary, obtain surety's consent to, or waiver of: (1) notice of changes in the Work; (2) request for reduction or release of retention; (3) request for final payment; and (4) any other information required by surety.

**ARTICLE 12 UNCOVERING AND CORRECTION OF WORK****§ 12.1 UNCOVERING OF WORK**

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's, Owner's or governing authority's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's, Owner's or governing authority examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect, Owner or governing authority has not specifically requested to examine prior to its being covered, the Architect, Owner or governing authority may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

**§ 12.2 CORRECTION OF WORK****§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION**

The Contractor shall promptly correct Work rejected by the Architect, Owner or governing authority or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

**§ 12.2.2 AFTER SUBSTANTIAL COMPLETION**

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.



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§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

**§ 12.3 ACCEPTANCE OF NONCONFORMING WORK**

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Contractor shall bear all direct, indirect and consequential costs attributable to Owner's evaluation of and determination to accept such defective or nonconforming Work (such costs to include but not limited to fees and charges of architects, engineers, testing agencies, consultants, attorneys and other professionals). Such adjustment shall be effected whether or not final payment has been made. If any such acceptance occurs prior to final payment, Owner shall be entitled to an appropriate decrease in the Contract Sum. If the acceptance occurs after final payment, an appropriate amount will be paid by the Contractor to the Owner.

**ARTICLE 13 MISCELLANEOUS PROVISIONS****§ 13.1 GOVERNING LAW**

The Contract shall be governed by the law of the State of North Carolina without regard to any Conflict of Laws doctrine.

**§ 13.2 SUCCESSORS AND ASSIGNS**

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project. In such event, the lender shall assume the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.2.3 Contractor shall not assign any monies due or to become due hereunder without written consent of Owner and of Contractor's Surety. File copy of consent of Surety, together with copy of assignment with Owner and Architect. In case Contractor assigns all or any part of any monies due or to become due under this Contract, instrument of assignment must contain clause substantially to effect that it is agreed that right of assignees in and to any monies due or to become due to Contractor shall be subject to prior liens and claims of all persons, firms and corporations for services rendered; for payment of all laborers and mechanics for labor performed; for payment for all materials and equipment furnished and payment for all materials and equipment used or rented in performance of the Work called for in Contract; and for payment of any liens, claims, or amounts due to governments or any of their funds.

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION****§ 13.3 WRITTEN NOTICE**

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

**§ 13.4 RIGHTS AND REMEDIES**

**§ 13.4.1** Duties and obligations imposed by the Contract Documents and rights and remedies available there under shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

**§ 13.4.2** No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach there under, except as may be specifically agreed in writing.

**§ 13.4.3** Provided however, any statement herein or elsewhere in the Contract Documents, of the Architect's Standard of Care and Quality shall not alter the Architect's contractual obligations owed to the Owner

**§ 13.5 TESTS AND INSPECTIONS**

**§ 13.5.1** Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the testing agency, Project inspector (if any), public authorities, and (if requested) the Architect, timely notice of when and where tests and inspections are to be made so that they may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

**§ 13.5.2** If the Architect, Owner, Project inspector (if any) or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Project inspector (if any) or Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the testing agency, Project inspector (if any), governing agency, and (if requested) the Architect of when and where tests and inspections are to be made so that they may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

**§ 13.5.3** If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, laws, ordinances, rules or regulations, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses shall be at the Contractor's expense.

**§ 13.5.4** Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect and Project inspector (if any).

**§ 13.5.5** If the Architect, Owner or Project inspector (if any) is to observe tests, inspections or approvals required by the Contract Documents, they will do so promptly and, where practicable, at the normal place of testing.

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§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5.7 Tests and Inspections: See Division 1 for additional requirements

§ 13.6 Preconstruction Conference: After execution of the Agreement, a conference will be held for review and acceptance of the schedule referred to in Paragraph 3.10, to establish procedures for handling shop drawings and other submittals, for processing Applications for Payment, and to establish a general working relationship among the parties to the Work. The conference will be held at a time and place to be determined by the Owner. The conference will be attended by a representative of the Contractor, the major subcontractors and material suppliers, the Architect and the Owner.

§ 13.7 Contractor's Responsibility For Additional Architect Fees: If more than two submittals are required for any shop drawing or other submittal, the Contractor shall be liable for any Architect fees incurred as the result of such submittals. If the Contractor defaults and causes the Architect to provide additional services, the Contractor shall be responsible for same. If the Contractor submits an extensive number of claims and the majority of such claims are rejected, the Contractor shall be responsible for any additional Architect fees for any such rejected claims. Any funds due under this paragraph shall be deducted by the Owner from the amounts due the Contractor for such additional Architect fees and paid directly to the Architect.

**ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT****§ 14.1 TERMINATION BY THE CONTRACTOR**

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents and a grace period of three (3) business days after written demand by the Contractor; or
- .4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead and profit on the Work performed.

**§ 14.2 TERMINATION BY THE OWNER FOR CAUSE**

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

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- .3 disregards laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority having jurisdiction; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, and the Owner believes that sufficient cause exists to justify such action, the Owner may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner within thirty (30) days after demand. This obligation for payment shall survive termination of the Contract.

**§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE**

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent;

- .1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

**§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE**

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

**ARTICLE 15 ADDITIONAL PROVISIONS****§ 15.1 LEGISLATIVE/REGULATORY COMPLIANCE AND MODIFICATION**

§ 15.1.1 The Contractor hereby agrees that it will comply with any and all statutes, laws, rules, regulations,

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licenses, certificates and authorizations of any governmental body or authority applicable to it in the performance or carrying out of its obligations under this Agreement. The Owner hereby agrees that it will comply with any and all statutes, laws, rules, regulations, licenses, certificates and authorizations of any governmental body or authority applicable to it in the performance or carrying out of its obligations under this Agreement. Each party will obtain and maintain current and in force all licenses, certifications, authorizations and/or permits (and will pay fees therefore) necessary for it to carry out its duties and responsibilities under this Agreement.

**§ 15.1.2** In the event any law, rule, regulation or payment policy, or any rule or policy of any non-governmental third-party payer, or any other federal, state or local law, rule, regulation, policy, or any interpretation thereof at any time during the term of this Agreement is modified, implemented, threatened to be implemented, or determined to prohibit, restrict or in any way materially change the method or amount of reimbursement or payment (a) for services under this Agreement, or (b) for services to patients of a party as a result of this Agreement, or by virtue of the existence of this Agreement has or shall have a materially adverse effect on the ability of either party to engage in any commercial activity on terms at least as favorable as those reasonably attributable as of the date hereof or by virtue of this Agreement place at risk the tax-exempt status of the Owner or the tax-exempt status of its financing vehicles (all of the foregoing being hereinafter collectively referred to as "Changes," and individually, a "Change"), then the parties to this Agreement shall negotiate in good faith to amend this Agreement to preserve the economic expectations of the parties to the greatest extent possible in a manner consistent with any such Change. If this Agreement is not amended in writing prior to the effective date of the Change, then the party affected by the Change may terminate this Agreement upon thirty (30) days advance written notice. Upon such termination, neither party shall have any further rights hereunder, except those rights already accrued and those that expressly survive termination.

**§ 15.2 OBRA COMPLIANCE**

**§ 15.2.1** The parties agree that upon request they will make their books, documents and records available to the Secretary of Health and Human Services, the comptroller general or their duly authorized representative to the extent required by Section 952 of the Omnibus Budget Reconciliation Act of 1980 and will obtain a similar agreement from any related sub-contractor whom they engage to perform on their behalf. This Section survives termination of this Agreement.

**§ 15.3 INDEPENDENT CONTRACTOR**

**§ 15.3.1** This Agreement does not constitute the Contractor, its employees and agents as employees, agents or legal representatives of the Owner for any purpose whatsoever, it being the intent of the parties hereto to create the relationship with the Contractor, its employees and agents of an independent contractor for whose actions or failure to act, the Owner shall not be responsible. The parties shall not exercise control or direct the manner in which other parties perform their duties hereunder except to assure compliance with this Agreement. The parties further agree that the Contractor, its employees and agents are not eligible for any Owner employee benefits whatsoever and do not possess any rights or privileges as generally established for the Owner's employees.

**§ 15.4 CONFIDENTIAL INFORMATION**

**§ 15.4.1** In the course of the Work both the Contractor and the Owner may receive information, data, items and materials relating to each other's personnel, business plans, methods and techniques, financing, financial condition, customers, lists, accounts, pricing, debts, assets, facilities and marketing, which we agree is Confidential Information. The Contractor and the Owner agree not to disclose the Confidential Information of the other party to any third party without express written consent either during the term of this Agreement or for two (2) years after its or expiration except as required by law.. Confidential Information does not include information that is (a) generally known in the industry in which the Contractor and the Owner compete; or (b) is readily ascertainable by proper means by competitors, through sources independent of either the Contractor or the Owner, or either party's personnel, through no act or no fault of the Contractor or the Owner.

**§ 15.5 COSTS**

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

**§ 15.5.1** Except as otherwise specifically provided herein, each party shall bear its own costs and expenses incurred in connection with the performance of its obligations hereunder.

**§ 15.6 TAXES**

**§ 15.6.1** Each party shall be responsible for payment of any and all federal, state, local or other taxes which may arise or be imposed as the result of its performance under this Agreement or as the result of the receipt of any compensation or other funds under this Agreement or in connection with the transactions contemplated hereby, if any. This Section shall survive termination of this Agreement.

**§ 15.7 INVALID PROVISION**

**§ 15.7.1** In the event that any portion of this Agreement shall be determined to be invalid or unenforceable, the remainder of this Agreement shall be deemed to continue to be binding upon the parties hereto in the same manner as if the invalid or unenforceable provision were not a part of this Agreement.

**§ 15.8 NON-WAIVER**

**§ 15.8.1** No waiver of any term or condition of this Agreement by either party shall be deemed to be a continuing or further waiver of the same term or condition or a waiver of any other term or condition of this Agreement.

**§ 15.9 COMPLIANCE WITH POLICIES AND PROCEDURES**

**§ 15.9.1** It is the responsibility of the Contractor to comply with, and to assure that its employees and agents comply with, all policies and procedures of the Owner, including but not limited to (and only when applicable), the Infection Control Policies, Occupational Health and Wellness, Blood-Borne Pathogens Policy (incorporated by reference) and the Substance Abuse Policy and Manual (incorporated by reference) and/or any subsequent changes to or revisions in these Policies and Procedures. Copies of these Policies and Procedures will be made available for review upon request by the Contractor. When applicable, it is also the responsibility of the Contractor to assure that its employees and agents comply with the Infectious Disease Control measures and requirements of the Owner, including but not limited to, current vaccinations and health screenings as required by the Infectious Disease Department of the Owner and to provide the Owner with a copy of current immunization records consistent with the Hospital's Occupational Health Department requirements.

**§ 15.10 COOPERATION**

**§ 15.10.1** In the event of any litigation against either party pertaining to any matter related to the other parties duties under this Agreement, both parties agree reasonably to cooperate with the other during the pendency of the claim or lawsuit including, without limitation, providing the other with all available information concerning the claim or lawsuit and meeting with the other or its representatives prior to giving testimony in connection with such claim or lawsuit, unless such cooperation adversely affects the party or the party is counseled by its attorney not to do so in order to preserve the attorney-client or any other privilege.

**§ 15.11 NON-DISCRIMINATION IN EMPLOYMENT**

**§ 15.11.1** Neither party shall discriminate because of race, color, religion, sex, age, national origin, disability, or status as a Vietnam veteran, as defined and prohibited by applicable law, in the recruitment, selection, training, utilization, promotion, termination or other employment-related activities concerning their employees. In addition, each party affirms that it is an equal opportunity employer and shall comply with all applicable federal, state and local laws and regulations.

**END OF GENERAL CONDITIONS 00797**

**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

**SECTION 01110 - SUMMARY OF WORK**

**PART 1 - GENERAL**

**1.1 SCOPE OF WORK**

**Renovation of an existing building.** Phased renovation includes selective interior demolition, plumbing, HVAC and electrical systems, and interior finish upgrades.

**1.2 SINGLE PRIME CONTRACT**

A. These documents form the Contract Documents for the Contract with the Owner as follows:

1. The Agreement;
2. The Addenda;
3. The General Conditions of the Contract;
4. Technical Specifications Divisions 00 through 26;
5. Asbestos and Lead Paint Survey Report
6. Drawings;
  - a) Cover Sheet;
  - b) Life Safety Sheet
  - c) A series sheets;
  - d) P series sheets;
  - e) M series sheets;
  - f) E series sheets;
  - g) S series sheets.

**1.3 CONTRACTOR'S USE OF PREMISES**

A. General:

1. Confine operations to areas within Contract limits indicated. Portions of the site beyond these limits shall not be disturbed.
2. Maintain the existing building in a weathertight condition throughout the construction period. Repair damage caused by construction operations immediately.

**1.4 OWNER OCCUPANCY:**

A. Building will be occupied during construction.

**1.5 OWNER-FURNISHED ITEMS: None**

**PART 2 - PRODUCTS** (Not Applicable).

**PART 3 - EXECUTION** (Not Applicable).

**END OF SECTION 01110**



**SECTION 01210 - ALLOWANCES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

A. Work Included in This Section:

1. This section specifies administrative and procedural requirements governing handling and processing of allowances.
2. Selected materials and equipment are included in the Contract Documents by allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct. Additional requirements, if necessary, will be issued by Change Order.
3. Unless otherwise provided in the Contract Documents all allowances:
  - a) shall be selected by the Owner
  - b) shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
4. Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum and not in the allowances;

**1.2 SUBMITTALS**

- A. Submit proposals for purchase of products or systems included in Allowances in the form of a Change Proposal Request (CPR).
- B. Submit invoices and/or delivery slips to substantiate actual quantities of materials delivered to the job site for use in fulfillment of the Allowance.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Coordinate materials and installation for each allowance item with related materials and installations to ensure that each allowance item is integrated with related construction activities.

**3.2 SCHEDULE OF ALLOWANCES**

- A. **ALLOWANCE NO. 1:** In addition to the Bid Price, the Owner will carry a \$100,000 allowance for the testing and abatement of potential asbestos and/or lead based paint contained in materials that may be impacted by the project scope of work within the building. Contractor shall submit a Request for Change Order to the Owner for review and approval prior to use of this allowance, if required, scope of work to be performed.

**PART 4 - END OF SECTION 01210**

**SECTION 012300 - ALTERNATES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for alternates.

**1.2 DEFINITIONS**

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

**1.3 PROCEDURES**

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.
- E. **PRODUCTS (Not Used)**

**PART 2 - EXECUTION**

**2.1 SCHEDULE OF ALTERNATES**

- A. Alternate No. #1:** Additive cost to perform all general conditions, architectural, demolition, mechanical, electrical, plumbing, and HVAC work in the basement.

**END OF SECTION 012300**

**SECTION 01250 - CONTRACT MODIFICATION PROCEDURES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

A. Work Included in This Section:

1. This section specifies administrative and procedural requirements for handling and processing Contract modifications.

**1.2 CHANGE PROPOSAL REQUESTS (CPR)**

- A. Prior to incorporation in a Change Proposal Request each proposed change in the Work, adjustment to the Contract Sum, or adjustment to the Contract Time will be identified as a Change Proposal Request (CPR) each of which will be assigned a number by the Engineer/Architect.
- B. Change Proposal Requests are for pricing and can be used to make minor changes in the work without invalidating the Contract.
- C. Proposals shall be submitted to the Engineer/Architect within 10 days of receipt by the Contractor of a Change Proposal Request; shall be complete in all respects; shall show the proposed effect on both the Contract Sum and the Contract Time; and shall not be withdrawn or modified by the Contractor for 30 days following submittal. Proposals shall be based on costs necessarily incurred by the Contractor in the proper performance of the Work. Such costs shall be at rates not higher than the standard paid at the place of the Project except with prior consent of the Owner. Proposals shall include only those items set forth below:
  1. Wages of construction workers directly employed by the Contractor to perform the construction of the Work, including welfare, unemployment compensation, social security and other benefits.
  2. Costs, including transportation, of materials and equipment incorporated or to be incorporated in the completed construction. All discounts for cash or prompt payment shall accrue to the Contractor.
  3. Payments made by the Contractor to Subcontractors in accordance with the requirements of the subcontracts.
  4. Cost of all materials, temporary facilities, equipment and hand tools not customarily owned by the construction workers, which are provided by the Contractor at the site and fully consumed in the performance of the Work.
  5. Reasonable rental costs for necessary temporary facilities, machinery, equipment, and hand tools used at the site of the Work, whether rented from the Contractor or others. Rates and quantities of equipment rented shall be subject to the Owner's prior approval. That portion directly attributable to this Contract of premiums for performance bonds.
  6. Losses and expenses not compensated by insurance or otherwise, sustained by the Contractor in connection with the Work, provided they have resulted from causes other than the fault or neglect of the Contractor.

7. Costs of removal of debris from the site.
8. Costs incurred in taking action to prevent threatened damage, injury or loss in case of an emergency affecting the safety of persons and property.
9. Other costs incurred in the performance of the Work if and to the extent approved in advance in writing by the Owner.

D. Proposals shall not include:

1. Salaries and other compensation of the Contractor's personnel stationed at the Contractor's principal office or offices.
2. Expenses of the Contractor's principal office and offices other than the site office.
3. Overhead and general expenses.
4. The Contractor's capital expenses, including interest on the Contractor's capital employed for the Work.
5. Rental costs of machinery and equipment, except as specifically provided in allowance for overhead and profit scheduled below.
6. Costs due to the fault or negligence of the Contractor, Subcontractors, anyone directly or indirectly employed by any of them, or for whose acts any of them may be liable, including, but not limited to, costs for the correction of damaged, defective or nonconforming Work, disposal and replacement of materials and equipment incorrectly ordered or supplied, and making good damage to property not forming part of the Work.
7. Any cost not specifically and expressly described in items 1 through 6 above.

**1.3 CHANGE PROPOSAL REQUEST PROCEDURES**

- A. Upon approval and execution by the Owner of a Change Proposal Request (CPR) and the Contractor's associated proposal the Contractor shall promptly proceed with the change in the Work involved. An approved Change Proposal Request (CPR) and the Contractor's associated proposal shall be considered the full amount of compensation, or credit, for the work involved, omitted, or substituted and no additional claims may be made regarding this item.
- B. At the time of signing a Change Proposal Request, the Contractor shall notify his Surety that the Contract Sum has been changed by the amount of this Change Proposal Request and he shall furnish his Surety with a copy of the approved Change Proposal Request.
- C. Change Proposal Request Format:
  1. Use the format included at the end of this Section for submittal of CPR's.

**PART 2 - PRODUCTS** (Not Applicable).

**PART 3 - EXECUTION** (Not Applicable).

**SEE FORMAT NEXT PAGE**

**CHANGE PROPOSAL REQUEST SUMMARY**

(a) <u>Materials</u> (Provide itemized breakdown)	\$	
	_____	
(b) <u>Rent of Equipment</u> (list Separately) At rates not in excess of those prevailing in locality of the project.	\$	
	_____	
<b>Sub-Total (1) [a + b]</b>		<b>\$</b>
		_____
(c) <u>Overhead &amp; Profit</u> (10% x Subtotal (1) for additive changes, 0% for deductive changes.)	\$	
	_____	
<b>Sub-Total (2) [Subtotal 1 + c]</b>		<b>\$</b>
		_____
(d) <u>Labor</u> (Provide itemized breakdown)	\$	
	_____	
(e) <u>Overhead &amp; Profit</u> (10% x Labor item (d) for additive changes, 0% for deductive changes.)	\$	
	_____	
<b>Sub-Total (3) [d + e]</b>		<b>\$</b>
		_____
(f) <u>Sub-Contract Work</u> (if applicable, same breakdown as shown above.)	\$	
	_____	
(g) <u>Contractor's Overhead and Profit on Sub-Cost</u> (5% for additive changes, 0% for deductive changes.)	\$	
	_____	
<b>Sub-Total (4) [f + g]</b>		<b>\$</b>
		_____
(h) <u>Insurance</u> (Workmen's Compensation, Social Security or as otherwise required and/or specified.)	\$	
	_____	
<b>Sub-Total (5) [Based on d]</b>		<b>\$</b>
		_____
(i) <u>Guarantee Bond</u> (on Sub-Total (2) + Sub-Total (3) or Sub-Total 4 as applicable)		<b>\$</b>
		_____
<b>Total</b>		<b>\$</b>
		_____

Extension of Time Requested: \_\_\_\_\_ calendar days.\*

\* Attach detailed justification.

**END OF SECTION 01250**

# Change Proposal Request

TO **Contractor**  
**Address**  
**City,State,Zip**

**Phone:** (   -   -   ) **Fax:** (   -   -   )

ATTENTION **Name of primary contact**

DATE	_____	PROJECT NO.	_____
PROJECT	<b>Lenoir County Courthouse HVAC and Basement Renovation</b>		
	<b>130 South Queen Street, Kinston, NC 28501</b>		
PROPOSAL REQUEST NO.	<b>1 (2,3 etc.)</b>		
RETURN BY	/ /2017 (10 days from date above)		
COPIES TO	<b>Lenoir County, Engineer/ Architect</b>		
	<b>File</b>		

Please submit an itemized quotation for changes in the Contract Sum and/or Time incidental to the proposed modifications to the Contract Documents described herein.

**DESCRIPTION:**

Detailed description of change

**ATTACHMENTS:**

Any attachemnts, drawings, sketches, etc., associated with change or none

**Net Amount of this Proposed Change:** (ADD) (DEDUCT) (NO CHANGE) \$ \_\_\_\_\_

**Net Change in Calendar Days due to this Proposed Change:** (ADD) (DEDUCT) (NO CHANGE) \_\_\_\_\_ DAYS

Contractor: \_\_\_\_\_

BY: \_\_\_\_\_ DATE: \_\_\_\_\_

ATTACH ALL APPLICABLE SUPPORTING DATA INCLUDING BREAKDOWNS, TAKE OFFS, SUPPLIERS QUOTES, ETC.

**All work shall be in accordance with the terms, stipulations and conditions of the original Contract Documents**

Contractor:		By:		Date:		
<b>Contractor Name</b>						
Architect:		By:		Date:		Recommendation:
<b>Dunn &amp; Dalton Architects, P.A.</b>						
Engineer						Recommendation:
<b>DeVita &amp; Associates, Inc.</b>						
Owner:		By:		Date:		Action:
<b>Lenoir County</b>						( ) Approved
						( ) Rejected

The Contractor is directed to make changes indicated above for the proposed amount and time after Owner approval.

If allowed by the Contract Documents, this document is considered a fully executed Change Order after Owner approval.

**SECTION 01290 - APPLICATIONS FOR PAYMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK:**

A. Work Specified In This Section

1. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

**1.2 SCHEDULE OF VALUES**

- A. The Schedule of Values shall be submitted on AIA-G702 and G703 forms and shall be in sufficient detail to show the work of each section of the Specifications and each line item shall further include a separate listing for Total Cost of Labor and Total Cost for Materials and Equipment.
- B. The Contractor(s) shall submit such data as may be required by the Engineer/Architect to establish the reasonableness of the value assigned to the labor and/or materials for each line item.
- C. The following minimum items in addition to the above shall be required:
  1. Pre-construction Cost:
    - a) Building permits and fees.
    - b) Bonds
    - c) Mobilization.
  2. On site General Conditions:
    - a) Job Site Superintendent and supervisory staff.
    - b) Office and Storage Trailers.
    - c) Utilities.
    - d) Clean-up, dumpster, etc.
  3. Project Close-Out Requirements.
  4. Home Office Overhead and Profit.
- D. In phased projects, the Schedule of Values shall be so arranged that each phase of the project is scheduled separately with line items for each of the various portions of the Work which constitute that phase. For each item, the Schedule of Values shall show separate line items for labor and materials. Along with separate line items for labor and materials; provide line items per each floor of each phase as directed by the Engineer/Architect.
- E. At the time of submitting the Schedule of Values, the Contractor shall also submit an estimate of the amount of each Request for Payment for the Owner's use in planning cash flow for the Project. It is understood that actual amounts requested by the Requests for Payment may not agree with this estimate.

**1.3 APPLICATIONS FOR PAYMENT**

- A. Unless otherwise agreed between the Owner and Contractor, the Contractor shall submit his requests for payment not later than the twenty-fifth day of each month. Requests shall be based on work performed during the period ending with the date of the request.



- B. The Owner will make a partial payment to the Contractor based on Contractor's requests duly certified, notarized and approved by the Engineer/Architect by the twenty-fifth of the following month.
- C. Until Substantial Completion, the Owner will pay ninety percent (90%) of the amount due the Contractor on account of progress payments.
- D. Upon Substantial Completion the Owner will continue to hold full amount of retainage until the Contractor achieves final completion.
- E. Each Request for Payment shall be accompanied by:
  - 1. Written consent of the Contractor's Surety.
  - 2. Such consent shall state that Surety agrees to payment of the sum requested, that the value of the work stated in the Contractor's request is a true statement, and that the sums requested for stored materials (if any) are correct.
  - 3. Provide Pay Application Summary Sheet (section 01291).
  - 4. Provide Certified Sales Tax Report. (section 01291).
  - 5. Coordination Drawings shall be submitted by the second Application for Payment. (if applicable to project).
  - 6. A monthly up-dated schedule signed by general contractor.
  - 7. Lien waivers.
  - 8. Previous Month's Project Monitoring Log.
  - 9. Proof of Payment Certification form (in accordance with section 00102).

#### 1.4 STORED MATERIALS

- A. In requesting payment for materials stored on or off the site, the Contractor shall submit with his Application for Payment the following:
  - 1. An itemized list of the stored material prepared in sufficient detail to identify the materials and their value.
  - 2. Evidence such as bills of sale or such other proof as may be requested by the Owner or Engineer/Architect to substantiate that the materials listed have been paid for by the Contractor, or for materials stored at the site only, a notarized statement from the materials supplier stating that the materials will become the property of the Owner upon payment by the Owner to the Contractor.
  - 3. In addition for material stored off the site, the Contractor shall submit with his Application for Payment the following:
    - a) Evidence that the materials are stored at the location previously agreed to in writing as provided by Subparagraph 9.3.2 of the General Conditions. No payment will be made for material stored off the site until the storage location has been agreed upon in writing.
    - b) Evidence that the storage location is bonded.
    - c) Evidence that the materials are insured while in storage and while in transit to the site.
    - d) Evidence that transportation to the site will be provided.
  - 4. The materials may be reviewed in their storage location by the Engineer/Architect. This review, if performed, is an extra service for which the Owner shall pay the Engineer/Architect and for which the Owner shall be reimbursed by the Contractor by Change Order.

**1.5 PROGRESS PAYMENTS**

- A. Provide with each Application for Payment, notarized waivers of lien from all subcontractors and material suppliers and if requested by the Owner:
  - 1. the Contractor's sworn statement showing names and addresses of all subcontractors furnishing materials or labor and the amounts due or to become due each;
  - 2. the Contractor's sworn statement showing the names and addresses of all material suppliers furnishing materials or labor and the amounts due or to become due or to become due each; and
  - 3. a sworn statement from each subcontractor showing names and addresses of all persons furnishing materials or labor and the amounts due or to become due each.

**1.6 FINAL PAYMENT**

- A. At the completion of the Project prior to receiving final payment, the Contractor shall furnish the Owner, through the Engineer/Architect, properly signed and notarized waivers of lien from all subcontractors employed and material suppliers furnishing materials for the Project. Such waivers shall be submitted before final payment will be processed to the Owner by the Engineer/Architect.
- B. Administrative actions and submittals that shall proceed or coincide with this application include:
  - 1. Notarized final waiver of lien.
  - 2. Occupancy permits and similar approvals.
  - 3. Warranties (guarantees) and maintenance agreements.
  - 4. Final test/adjust/balance records.
  - 5. Maintenance instructions.
  - 6. Start-up performance reports.
  - 7. Final cleaning.
  - 8. Consent of Surety.
  - 9. Verification of continued insurance.
  - 10. Completion of Project closeout requirements.
  - 11. Completion of items specified for completion after Substantial Completion.
  - 12. Assurance that unsettled claims will be settled prior to payment.
  - 13. Assurance that Work not complete and accepted will be completed without delay.
  - 14. Transmittal of required Project construction records to Owner.
  - 15. Certified property survey (if required).
  - 16. Proof that taxes, fees and similar obligations have been paid.
  - 17. Removal of temporary facilities and services.
  - 18. Removal of surplus materials, rubbish and similar elements.
  - 19. Change of door locks to Owner's access.

**PART 2 - PRODUCTS** (Not Applicable)

**PART 3 - EXECUTION** (Not Applicable)

**END OF SECTION 01290**

## SECTION 01315 - PROJECT MEETINGS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

A. Work Included This Section:

1. This Section specifies administrative and procedural requirements for project meetings including but not limited to:
  - a) Pre-Construction Conference.
  - b) Coordination Meetings.
  - c) Progress Meetings.

#### 1.2 PRE-CONSTRUCTION CONFERENCE

A. A pre-construction conference shall be scheduled by the Engineer/Architect and held at the Project site or other convenient location after execution of the Agreement or Notice To Proceed, whichever comes first and prior to commencement of construction activities.

B. Attendees:

1. The Owner, Engineer, Architect, the Contractor(s) and its superintendent(s) shall each be represented at the conference by persons authorized to conclude matters relating to the Work.

C. Agenda:

1. Discuss items of significance that could affect progress including such topics as:
  - a) Work sequencing.
  - b) Tentative construction schedule.
  - c) Designation of responsible personnel.
  - d) Procedures for processing Change Proposal Requests and Change orders.
  - e) Procedures for processing Applications for Payment.
  - f) Submittal of Shop Drawings, Product Data and Samples.
  - g) Preparation of record documents.
  - h) Use of the premises.
  - i) Staging areas.
  - j) Security.
  - k) Housekeeping.

#### 1.3 COORDINATION MEETINGS

A. The General Contractor shall conduct project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special Pre-installation meetings.

- B. Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting, such as the Owner and Engineer/Architect.
- C. Weekly Progress Meetings:
  - 1. To enable orderly review of progress during construction and to provide for systematic discussion of problems, weekly project meetings shall be held throughout the construction period.
  - 2. Persons designated by each Subcontractor shall attend and participate in weekly project meetings shall have all required authority to commit the Contractor or Subcontractor to decisions agreed upon in the project meetings.
  - 3. The General Contractor shall conduct the meetings, compile minutes of each meeting and will distribute copies to the Owner and the Engineer/Architect. The General Contractor shall distribute such other copies as he wishes. Each Contractor shall, to the maximum extent practicable, assign the same person or persons to represent the Contractor or Subcontractor at project meetings throughout the construction period.
- D. Owner, Engineer, Architect, Contractor (OAC) Project Meetings:
  - 1. To enable orderly review of progress during construction and to provide for systematic discussion of problems, project meetings shall be held throughout the construction period at intervals determined prior to construction.
  - 2. The General Contractor shall attend and participate in the OAC project meetings and shall have all required authority to commit the Contractor and Subcontractor(s) to decisions agreed upon in the project meetings.
  - 3. The Engineer/Architect will conduct the OAC meetings and compile minutes of each meeting and will distribute copies to the Owner and Contractor. The Contractor shall distribute such other copies as required. The General Contractor shall, to the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout the construction period.

**PART 2 - PRODUCTS** (Not Applicable)

**PART 3 - EXECUTION** (Not Applicable)

**END OF SECTION 01315**

**SECTION 01325 - PROGRESS SCHEDULES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

A. Work Specified In This Section:

1. This Section specifies administrative and procedural requirements for the progress schedules and reporting progress of the Work.
2. Refer to General Conditions and the Agreement, for definitions and specific dates of Contract Time.

**1.2 QUALITY ASSURANCE**

A. General:

1. The General Contractor shall provide the progress scheduling services, including planning, evaluating and reporting.
2. The Contractor shall deliver the construction schedule to the Owner/Engineer/Architect at the Pre-Construction Meeting.
3. No later than 5 days following the Pre-Construction meeting, the completed Construction Progress Schedule, bearing the approval signature of the Contractor, shall be submitted to the Owner and Engineer/Architect.

**1.3 PROGRESS SCHEDULE**

A. CPM Schedule:

1. Immediately following Contract Award, the General Contractor shall hold a meeting with the construction team for the purpose of establishing and preparing a Construction Progress Schedule.
  - a) Each major subcontractor shall be represented.
2. The Contractor shall develop a schedule demonstrating fulfillment of the contract requirements, shall keep the network up-to-date in accordance with the requirements of the contract and shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of Prime contractors, subcontractors, equipment vendors and suppliers).
3. Conventional Critical Path Method (CPM) Precedence Diagramming Method (PDM) technique will be utilized to satisfy time applications.
4. The Construction Progress Schedule, utilizing a critical path method of scheduling, shall be detailed to a degree, which will permit proper and complete coordination of all trades in each portion of the work.

## B. Network Diagram Requirements:

1. Show on the network diagram the sequence and interdependence of work activities/events required for complete performance of all items of work.
2. In preparing the network diagram, the Contractor shall:
  - a) Exercise sufficient care to produce a clear, legible and accurate network diagram.
3. Show the following on each work activity/event:
  - a) Activity/Event ID numbers.
  - b) Concise description of the work represented by the activity/event.
  - c) Duration (in work days.)
  - d) Manpower required (average number of men per day if requested).
  - e) Indicate predecessor in column format.
4. Show activities/events as:
  - a) Contractor's time required for submittal of shop drawings.
  - b) Architect-Engineer's review and approval of shop drawings.
  - c) Delivery of Owner furnished equipment, project phasing, Authority Having Jurisdiction inspections, and any other specification requirements.
5. Test, balance and adjust various systems and pieces of equipment.
6. Therefore, the schedule shall specifically indicate the following dates:
  - a) List of testing requirements for all Specification Sections required by the Contractor's CQC Plan.
  - b) The date of satisfactory enclosure.
  - c) Dates scheduled for delivery of major items of equipment.
  - d) Dates scheduled for completion of installation of major items of equipment.
  - e) The anticipated date of Substantial Completion for each phase of construction and local and state Authority Having Jurisdiction inspections per phase.  
Owner Training.
  - f) Dates scheduled for owner occupancy of completed phased areas and dates for moving of owner's equipment into said areas.
  - g) Project closeout, as established by the Contract.
  - h) The date of Final Completion of the project, as established by the Contract.
7. Submit the following supporting data in addition to the network diagram:
  - a) The proposed number of working days per week.
  - b) The Owner's holidays to be observed during the life of the contract (by day, month, and year).
  - c) The planned number of shifts per day (if requested).
  - d) The number of hours per shift (if requested).

## C. Post original and current copy of the schedule in the Project Coordinator's field office.

## D. Phasing:

1. Provide notations on the schedule to show how the sequence of the Work is affected by requirements for phased completion to permit Work by Contractor and partial occupancy by the Owner prior to Substantial Completion.

## E. Schedule Updating:

1. Updated project schedule will be presented at the OAC meeting. Data dates should be no later than 5 days prior to the OAC meeting.
2. Issue the updated schedule concurrently with report of each meeting.
3. Updated schedule shall include the original baseline task bar with date and current task bar with date. All schedule updates shall indicate predecessors in column format. The schedule update shall include the data date.

## F. Format:

1. Display the full network on stable transparency, or other reproducible media, of sufficient width to show data clearly for the entire construction period.
    - a) Provide three (3) complete color schedules to the Architect.
    - b) Provide complete color schedule in the Project Coordinator's trailer.
  2. Construction Schedule shall indicate the baseline schedule.
  3. Mark the critical path in red.
  4. Locate the critical path near the center of the network
  5. Sub networks on separate sheets are permissible for activities clearly off the critical path.
- G. At the time of submitting the Construction Progress Schedule to the Engineer/Architect, the Contractor shall also submit the anticipated amount of each monthly payment that will become due in accordance with the Progress Schedule(if requested).
1. When the Contractor fails or refuses to furnish formation and the associated updated schedule data, which, in the sole judgment of the Owner and Engineer/Architect, is necessary for processing the monthly progress payment, the Contractor shall not be deemed to have provided supporting schedule data upon which progress payment may be made.

**1.4 PROGRESS REPORTING**

## A. Job progress will be reviewed to verify:

1. Actual start and/or finish dates for updated/completed activities/events.
2. Remaining duration, required to complete each activity/event started, or scheduled to start, but not completed.
3. Logic, time, and approved CPR's with time for change orders, and supplemental agreements that are to be incorporated into the network diagram and computer-produced schedules.
4. Percentage for completed and partially completed activities/events.
5. Activity/event duration and percent complete shall be updated independently

**1.5 RESPONSIBILITY FOR COMPLETION**

- A. Whenever it becomes apparent from the current monthly progress review meeting that phasing or contract completion dates will not be met, the Contractor(s) shall execute some or all of the remedial actions stipulated in the General Conditions, Section 00797.
- B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Owner furnished equipment, must be furnished in writing to the Owner for approval.
1. Any service charges, i.e. additional fees associated with the revisions including storage, redelivery fees, etc. shall be the responsibility of the contractor.

**1.6 ADJUSTMENT OF CONTRACT COMPLETION**

- A. Request for an extension of the contract completion date by the Contractor(s) shall be supported with a justification, CPM data and supporting evidence.

- B. Actual delays in activities/events which, according to the computer-produced calendar-dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date.

**1.7 OWNER'S HOLIDAYS**

- A. The following Holidays are to be considered non-working days and should be reflected as such in the Contractor's Construction Schedule:
  - 1. New Year's Day
  - 2. Martin Luther King Jr's Birthday
  - 3. Easter (Good Friday)
  - 4. Memorial Day
  - 5. Independence Day
  - 6. Labor Day
  - 7. Thanksgiving Day
  - 8. Christmas Eve and Christmas Day
  
- B. Unless noted otherwise, work hours shall be 7:00 am through 5:00 pm, Monday through Friday. No work shall be scheduled outside of these times or during weekends unless approved in advance by the Owner.

**PART 2 - PRODUCTS** (Not Applicable).

**PART 3 - EXECUTION** (Not Applicable).

**END OF SECTION 01325**



## SECTION 01330 - SUBMITTALS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

A. Work Included This Section:

1. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including:
  - a) Submittal schedule.
  - b) Shop Drawings.
  - c) Product Data.
  - d) Samples.

B. Administrative Submittals:

1. Refer to Division-1 and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
  - a) Permits.
  - b) Applications for payment.
  - c) Performance and payment bonds.
  - d) Insurance certificates.

#### 1.2 SUBMITTAL PROCEDURES

A. Submittal Preparation:

1. Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
2. Include the following information on the label for processing and recording action taken:
  - a) Project name and Engineer/Architect's project number.
  - b) Date.
  - c) Name and address of Engineer/Architect.
  - d) Name and address of Contractor.
  - e) Name, phone number and address of subcontractor.
  - f) Name, phone number and address of supplier.
  - g) Name, phone number of manufacturer and his representative.
  - h) Number and title of appropriate Specification Section.
  - i) Drawing number and detail references, as appropriate.
3. As a result of the Contractor's review, the Contractor shall indicate that the result of his review was:
  - a) "Reviewed and Approved"
  - b) "Reviewed – Approved As Noted"Prior to submission to the Engineer/Architect.
4. If appropriate, and/or permitted by the Contract Documents, the Contractor may stamp the Drawings or Submittal information "Received for Record Purposes Only", if no review of the material, by the Contractor, is required by the Contract Documents.
5. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.

6. Provide shop drawings or submittal information individually. Do not group like trades into one submittal binder.
- B. Identification Number:
1. Each Submittal shall be numbered to comply with the following ***example***:
    - a) The numbering system will use the specification section as the initial submittal number, i.e. for items required in Section 06190 – Wood Trusses – the submittal will be “06190.01”. The “01” identifies the submittal as the first, or submittal number one (1) under that specification section. If additional submittals are required under Section 06190, then the second submittal will be identified as “06190.02”, in sequence. In the event a submittal is returned (example above – 06190.02) to the Contractor, and is marked either “Reviewed and Disapproved” or “Reviewed – Revise and Resubmit”, then, the revised submittal will be identified as 06190.02.A, with the suffix “A” indicating the first resubmittal of this item, and using, progressive letters in the event of multiple re-submittals.
- C. Submittal Review by Contractor:
1. The Contractor is required to review each submittal, including, but not limited to, shop drawings, product data, samples, cut sheets and similar submittals.
  2. Submittals on items, materials, installations, products or vendors that are not specified or indicated on the drawings will be considered **substitutions**, and as such, must comply with provisions of Section 01631 – Product Substitutions, of this Project Manual.
  3. Following the Contractor review of the submittal, the Contractor will place a “review stamp” on each copy of each submittal, and sign, date and indicate action taken in conformance with the “Submittal Preparation” sub-section of this Section. The same information indicated on the Contractor’s review stamp will also be indicated on the “Submittal Transmittal” form included with this Section.
  4. By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that he has determined, or will do so, the suitability of materials, field measurements and field construction and criteria related thereto, and has checked and coordinated the information contained within such submittals, with the requirements of the Work and the Contract Documents.
  5. The responsibility for coordinating the Shop Drawings, including technical data, capability (warranted and implied), sizing, color, texture, etc. shall be the sole responsibility of the Contractor. The coordination between subcontractor and/or materials supplier shall be the responsibility of each Contractor/Prime Contractor. The Project Coordinator, as defined in the Specifications, shall be responsible to supervise this activity.
  6. Submittals that do not comply with provisions of this sub-section will be returned not reviewed, not logged and will be considered non-responsive.
- D. Partial Submittals:
1. Partial or incomplete submittals are not acceptable. Any submittal or shop drawing received by the Engineer/Architect, that does not contain all portions required by each Section of the Specification, will be returned not reviewed, not logged and will be considered non-responsive.
  2. Exceptions will be considered on a case by case basis, such as duct drawings and structural steel drawings on multi-level, multi phased or multi-zone projects. Requests for exceptions must be submitted in writing by the Contractor for evaluation and response, a minimum of 30 days prior to the submittal date indicated on the Contractor’s approved/updated Submittal Schedule.
- E. Submittal Review by Engineer/Architect:

1. The Engineer/Architect will review each of the Contractor's submittals one initial time, and, should re-submittal be required, one additional time to verify that the reason(s) for re-submittal have been addressed by the Contractor and corrections made. Any review required by the Engineer/Architect, other than the two (2) indicated above, will be considered additional scope of work for the Engineer/Architect, and the Contractor shall reimburse the Owner for all costs incurred, including the cost of the Engineer/Architect's services, made necessary to review such additional re-submittals.

### 1.3 SUBMITTAL SCHEDULE

#### A. Shop Drawings:

1. The Contractor shall prepare and submit to the Engineer/ Architect, not later than 30 days following the Date of Commencement, and prior to the Contractor's first Application for Payment, a schedule of all Shop Drawings and Submittals as required by the Contract Documents. No Applications for Payment will be reviewed or approved until receipt and approval of the Submittal Schedule.
2. Schedule shall indicate dates for submission. The Contractor is required to submit a monthly updated submittal schedule with each Application for Payment. Pay applications received without the Submittal Schedule update will not be reviewed and will be returned to the Contractor.
3. All Shop Drawings, Samples and Submittals for approval shall be completed within sixty (60) calendar days following the Date of Commencement.
4. Coordinate the Schedule with the schedule of the individual subcontractors, suppliers or vendors, and the Contractor's Construction Schedule.
5. The Engineer/Architect will schedule his manpower to review submittals based on the time limits established above. Submittals by the Contractor received beyond the time limit established above may affect the Engineer/Architects manpower schedule resulting in additional cost; the Contractor shall reimburse the Owner for the costs of the Engineer/Architect's services for the review or approval beyond the time stipulated above.

### 1.4 SHOP DRAWINGS

#### A. General:

1. All submittals shall be dated and shall contain the project name; description or names of equipment; materials or equipment which are to be installed, reference to the Section of Specifications where it is specified and Drawing number where shown.
2. The use of Contract Documents for submittal of shop drawing is prohibited.

#### B. Shop Drawings:

1. Submit legible, unfolded, double-coated, reproducible transparencies (positive side up sepia) of each drawing. Each drawing shall have a clear space for stamps per requirement of the Submittal Preparation above.
2. When phrase "by others" appears on Shop Drawings, the Contractor shall indicate on drawing whom is to furnish material or operations so marked before submittal.
3. When Shop Drawings are marked after review by the Engineer/Architect, with any variation of the wording "resubmit", or words of like meaning, the Contractor shall correct the original tracing and submit a new transparency for approval, to the Engineer/Architect. After the Engineer/Architect completes a review of each Shop Drawings transparency, the Engineer/Architect will return only the marked up or reviewed

transparency to the Contractor. Additional prints required by the Contractor for further or other use(s), other trades, suppliers, vendors, shall be provided by the Contractor as required.

4. Electronic copies of the Contract Document, for use in preparing Coordination Drawings, may be furnished by the Engineer/Architect only after:
  - a) The Contractor submits a request for same in writing to the Owner.
  - b) The Owner forwards, to the Engineer/Architect, a copy of the Contractor's request, together with a signed "Electronic Data Transfer Letter Agreement" which will indicate the Owner's approval of the Contractor's request for electronic copies of the Contract Documents.
  - c) Contractor's written agreement to pay for an Engineer/Architect's "Change in Services" which will permit additional fee to the Engineer/Architect for services connected with the furnishing of Electronic Data to the Contractor.

C. Sheet Size:

1. Submit Shop Drawings on sheets 24"x36" or smaller.

## 1.5 MANUFACTURER'S LITERATURE

- A. For standard manufactured items not requiring special shop drawings for manufacture, submit sufficient copies of manufacturer's catalog sheets to permit the Engineer/Architect to retain one copy, provide one copy for the Owner, and to return adequate copies for the Contractors use and distribution. Catalog cuts shall be of item to be furnished, showing scale details, sizes, dimensions, performance characteristics, capacities, wiring diagrams and controls, and all other pertinent information necessary for a review by the Engineer/Architect.

## 1.6 MATERIAL SAFETY AND DATA SHEETS (MSDS)

- A. Provide MSDS sheets as follows:
  1. One set to keep on site at all times
  2. One set to be submitted for final close-out documents. See Section 01781 - Project closeout for more information.
  3. Do not forward MSDS to the Engineer/Architect for Review or distribution.

## 1.7 SAMPLES

- A. Unless otherwise specifically directed by the Engineer/Architect, all Samples shall be of the precise article proposed to be furnished by the Contractor.
- B. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3), that show approximate limits of the variations.
- C. Refer to Specifications for requirements for Samples that illustrate workmanship, fabrication techniques and details of assembly, connections, operation and similar construction characteristics.
- D. Submit all Samples in the quantity that is required to be returned plus one which will be retained by the Engineer/Architect.

**PART 2 - PRODUCTS** (Not Applicable).

**PART 3 - EXECUTION** (Not Applicable).

**END OF SECTION 01330**

**SECTION 01500 - TEMPORARY FACILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK:**

**Work Specified In This Section -**

1. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

**1.2 QUALITY ASSURANCE:**

**Regulations -**

1. Comply with industry standards and applicable laws and regulations of authorities having jurisdiction.

**1.3 PROJECT CONDITIONS:**

**Conditions of Use -**

1. Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

**PART 2 - PRODUCTS**

**2.1 TEMPORARY FACILITIES:**

1. **Sanitary Facilities:** Provide and maintain in a neat and sanitary condition chemical type toilet facilities which comply with the requirements and regulations of the Department of Health or of other bodies having jurisdiction. These facilities shall be available to all workers on the job.
2. **Drainage:** Keep excavations, pits, trenches, footings, and floors free from water to protect all work and to afford satisfactory working conditions. Provide any temporary ditches, sumps, pumps, or drains necessary for this purpose.
3. **Water Service:** Use of the existing water service (at the County Courthouse) is allowed.
4. **Light and Power Service:** Use of the existing Owner's electrical service is allowed.

**END OF SECTION 01500**

**SECTION 01631 - PRODUCT SUBSTITUTIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

A. Work Specified This Section:

1. This Section specifies administrative and procedural requirements for handling requests as a substitution request made after the Notice to Proceed or award of the Contract as a CPR.

**1.2 SUBMITTALS**

A. Substitution Request Submittal:

1. Submit 3 copies of each request for substitution for consideration.
2. Submit each request on the attached form and in accordance with procedures required for Change Proposal Requests (CPR). See Section 01250 for additional information.
3. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
4. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
  - a) Original copies of Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
  - b) Samples, where applicable or requested.
  - c) A detailed point by point comparison of the proposed substitution and the specified product detailing the significant qualities of both products.
    - 1) Significant qualities may include elements such as size, weight, durability, performance and visual effect.
  - d) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
  - e) A statement indicating the substitutions effect on the Contractor's Construction Schedule.
  - f) Cost information, including a proposal of the net deduct change in the Contract Sum.
  - g) Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated.
    - 1) Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

B. Engineer/Architect's Action:

1. After receipt of the request for substitution, the Engineer/Architect may request additional information or documentation necessary for evaluation of the request.
2. If a decision on use of a proposed substitute is not made or obtained within sufficient time to have no adverse impact on the construction schedule, the Contractor shall use the product specified in the Contract Documents.

**PART 2 - PRODUCTS (NOT APPLICABLE)**

**PART 3 - EXECUTION**

**3.1 SUBSTITUTIONS:**

A. Conditions:

1. No substitution will be considered unless such request include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for a complete comparison with the specified products or materials and an evaluation of the proposed products or materials.
2. A statement setting forth changes in other materials, equipment or other portions of the Work including changes in the work of other contracts that incorporation of the proposed substitution would require shall be included.
3. Savings or Credit to Owner for accepting substitution
4. The burden of proof of the merit of the proposed substitution is upon the proposer.
5. In addition to the requirements in the Supplemental General Conditions, the following items will apply:
  - a) The substitution is in compliance with subsequent interpretations of code or insurance requirements.
  - b) The manufacturer or fabricator shall certify or guarantee the specified product as required by the Contract Documents.
  - c) Product shall perform properly and fit in the designated space.

B. The Contractor shall bear all expenses resulting from substitutions including the cost of work in general, structural, plumbing, mechanical and electrical trades required due to the substitution and the cost of any Engineer/Architect's services made necessary by the substitution.

C. The Engineer/Architect's decision of approval or disapproval of a proposed substitution shall be final.

**3.2 SUBMITTAL FORMS:**

A. All proposed substitutions shall use the following form.



**SUBSTITUTION  
REQUEST**

---

Project: \_\_\_\_\_ Substitution Request No \_\_\_\_\_  
 \_\_\_\_\_ CPR No. (After Bid) \_\_\_\_\_  
 \_\_\_\_\_ From: \_\_\_\_\_  
 To: \_\_\_\_\_ Date: \_\_\_\_\_  
 \_\_\_\_\_ A/E Project No. \_\_\_\_\_  
 Re: \_\_\_\_\_ Contract For: \_\_\_\_\_

---

Specification Title/or Drawing Sheet: \_\_\_\_\_

Section No.: \_\_\_\_\_ Page No.: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone #: \_\_\_\_\_

Trade Name: \_\_\_\_\_ Model #: \_\_\_\_\_

Installer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone #: \_\_\_\_\_

History: New Product:      2 -5 years old      5-10 years old      More than ten years old

Briefly explain differences between proposed substitution and specified product \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Point-by-Point comparative data attached - REQUIRED BY A/E

\_\_\_\_\_

Reason for not providing specified item: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Similar Installation:**

Project: \_\_\_\_\_  
\_\_\_\_\_

Engineer/Architect: \_\_\_\_\_

Address: \_\_\_\_\_

Owner: \_\_\_\_\_

Telephone: \_\_\_\_\_

Owner Representative: \_\_\_\_\_

Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work: No Yes; explain \_\_\_\_\_

Savings or Credit to Owner for accepting substitution: \_\_\_\_\_ (\$ \_\_\_\_\_)

**(MUST BE FILLED OUT TO RECEIVE REVIEW.)**

Proposed substitution changes Contract Time: No Yes; Add/Deduct \_\_\_\_\_ days.

Supporting Data Attached:

Product Data	Drawings	Tests	Reports	Samples	_____
Fire Tests	Acoustical Tests				
ASTM Tests	UL, FM or WHI listed: provide copy of test reports.				

Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same or better warranty will be furnished for proposed substitution as for specified product.
- Same or better maintenance service and source of replacement parts, as applicable is available.
- Proposed substitution will not affect or delay Progress Schedule.
- Cost data as stated above is complete. Contractor (s) claims for additional costs related to accepted substitution, which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for A/E changes to building design, including architectural or engineering design, detailing, and construction costs caused by the requested substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted By: \_\_\_\_\_

Signature: \_\_\_\_\_

Firm: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_ Approved By: \_\_\_\_\_  
General Contractor Date

Attachments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

ENGINEER/ARCHITECT'S REVIEW AND ACTION

Substitution approved - Make submittals in accordance with Division One.

Substitution approved as noted - Make submittals in accordance with Division One.

Substitution rejected - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

Additional Comments Contractor Subcontractor Supplier Manufacturer A/E \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

END OF SECTION 01631

**SECTION 01740 - FINAL CLEANING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

- A. Work Included This Section:
  - 1. This Section specifies administrative and procedural requirements for final cleaning at Substantial Completion.
- B. Environmental Requirements:
  - 1. Conduct cleaning and waste disposal operations in compliance with all laws and ordinances. Comply fully with federal and local environmental and anti-pollution regulations.
  - 2. Burning or burying of debris, rubbish or other waste material on the premises shall not be permitted.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Cleaning Agents:
  - 1. Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property, or that might damage finished surfaces.

**PART 3 - EXECUTION**

**3.1 FINAL CLEANING**

- A. General:
  - 1. Employ experienced workers or cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a professional building cleaning and maintenance program. Comply with manufacturer's instructions.
  - 2. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion for the entire Project or a portion of the Project:
    - a) Remove tools, construction equipment, machinery and surplus material from the site.
    - b) Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original condition.
    - c) Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.
    - d) Broom clean concrete floors and walks.
    - e) Clean transparent materials, including mirrors and glasses in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

- f) Remove labels that are not permanent labels.
- g) Touch-up and otherwise repair and restore marred exposed finishes and surfaces. Replace finishes and surfaces that can not be satisfactorily repaired or restored, or that show evidence of repair or restoration.
- h) Carefully, remove all paint over "UL" and similar labels, including mechanical and electrical nameplates and doors and door frames. All labels shall be like new and readable.
- i) Leave the Project clean and ready for final inspection.

**END OF SECTION 01740**

**SECTION 01781 - PROJECT CLOSEOUT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

A. Work Included This Section:

1. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
  - a) Inspection procedures.
  - b) Project record document submittal.
  - c) Operating and maintenance manual submittal.
  - d) Submittal of warranties.
  - e) Access badges and parking passes
2. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions 2 through 26.

**1.2 SUBSTANTIAL COMPLETION**

A. General:

1. The Work or designated portion thereof will not be considered suitable for Substantial Completion until all systems are operational as designed; all designated or required governmental inspections or certifications have been made and posted, including those of the Division of Health Service Regulation (DHSR), designated instruction of Owner's personnel in the operation of systems has been completed, and all final finishes are in place.
2. As a further condition of Substantial Completion, the Contractor(s) shall certify that all remaining work will be completed within 30 consecutive calendar days following the Date of Substantial Completion, and the failure to do so shall automatically reinstate the provisions for damages due the Owner as contained elsewhere in the Agreement or as provided by law for such period of time as may be required by the Contractor to fully complete the work whether the Owner has occupied the work or not.
3. Upon Substantial Completion of the Work or designated portion thereof and upon application by the Contractor and recommendation by the Engineer/Architect, the Owner shall make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof as provided in the Contract Documents.

B. Forms:

1. All forms to be used shall be American Institute of Architect (AIA) forms.

C. Preliminary Procedures:

1. Advise Owner of pending insurance changeover requirements.
2. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
3. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
4. Deliver tools, spare parts, extra stock, and similar items.
5. Make final changeover of permanent locks and transmit keys to the Owner.

- a) Advise the Owner's personnel of changeover in security provisions.
  6. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel.
    - a) Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
  7. Complete final clean up requirements, including touch-up painting.
    - a) Touch-up and otherwise repair and restore marred exposed finishes.
- D. Inspection Procedures:
1. Upon receipt of a request for inspection for Substantial Completion, the Engineer/Architect will either proceed with inspection or advise the Contractor(s) of incomplete requirements.
    - a) The Engineer/Architect will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
  2. The Engineer/Architect will repeat inspection when requested in writing by the Contractor and assured that the Work has been substantially completed and all items that were incomplete have been corrected.
  3. Results of the completed inspection will form the basis of requirements for final acceptance.
- E. Re-inspection Procedure:
1. In the event that more than the two inspections by the Engineer/Architect, described above are made necessary by the failure of the Contractor(s) to complete the work or to complete or correct items identified on the list of such items, a CPR will be established for re-inspection.
    - a) The Contractor(s) shall reimburse the Owner for all costs incurred including the cost of the Engineer/Architect's services made necessary thereby.
  2. Upon completion of re-inspection, the Engineer/Architect will prepare a Certificate of Substantial Completion, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for Substantial Completion.
  3. If necessary, a CPR will be established for re-inspection will be repeated at the Contractor's expense and the amount deducted from his Application for Payment.

### 1.3 FINAL ACCEPTANCE

- A. At the completion of the Project prior to receiving final payment, the Contractor shall furnish the Owner, through the Engineer/Architect, properly signed and notarized waivers of lien from all subcontractors employed and material suppliers furnishing materials for the Project. Such waivers shall be submitted before final payment will be certified by the Engineer/Architect to the Owner (AIA G706A)
- B. Preliminary Procedures:
1. Before requesting final inspection for final payment, submit and complete the following (list exceptions in the request):
    - a) Submit a copy of the Engineer/Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and the list has been endorsed and dated by the Engineer/Architect.
    - b) Submit record drawings, maintenance manuals, final project photographs (if any), and similar final record information.

- c) Submit Consent of Surety to Final Payment (AIA G707).
- d) Guarantees, Warranties and Bonds.
- e) Keys and keying schedule.
- f) Spare parts and Maintenance Materials.
- g) Certificate of Insurance for Products and Completed Operations.
- h) Certificate of Occupancy if required.
- i) All remnants required by the Contract Documents.
- j) Return access badges and parking passes to client's Project Manager
- k) Any other items as required by the Engineer/Architect and/or Owner.

#### 1.4 RECORD DOCUMENT SUBMITTALS

##### A. General:

1. The Contractor(s) shall record on the Record Drawings maintained at the site all changes and selections made during construction and shall locate by dimensions showing actual field measurements of all major items which will be concealed in the completed Work.
  - a) These items shall include underground piping and conduit beneath slabs-on-grade (or basement slabs), underground site utilities such as pipe, conduit, storm drainage, sewer, gas, water, medical gases, oil, and telephone, etc. and items above hard ceilings such as duct, pipe, etc.
  - b) Elevations are to be established at fifty foot intervals and at all changes in direction using bench marks or finish floor elevations.
2. Dimensions are to be taken from face of building lines to centerline of piping or conduit.
3. The Contractor will accurately locate all under floor services at slab on grade areas by dimension from building line or column centerlines.
  - a) Elevations are to be established from finish floor lines.
4. Where new lines cross existing installed lines the location, size and type of line crossed shall be accurately recorded.
5. Where tie-ins to existing under floor lines are indicated the elevation of the tie-in point and dimensioned location shall be recorded.
6. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer/Architect's reference during normal working hours.

##### B. As Built Drawings:

1. As built drawings shall be provided to reflect changes (CPRs) in the Work and locations of concealed items for all trades including plumbing, mechanical, electrical, and general construction.
2. Mark the set, using red, to show the actual installation where the installation varies substantially from the Work as originally shown.
3. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings.
  - a) Give particular attention to concealed elements that would be difficult to measure and record at a later date.
4. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
5. Note related Change Order numbers where applicable.

##### C. Record Specifications:



1. Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders (CPRs) and modifications issued in printed form during construction.
  - a) Mark these documents to show variations in actual Work performed in comparison with the text of the Specifications and modifications.
  - b) Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation.
  - c) Note related record drawing information and Product Data.
2. Upon completion of the Work, submit record Specifications to the Engineer/Architect for the Owner's records.

D. Shop Drawings:

1. Deliver Contractor's approved copy of all shop drawings submitted during the course of the project.

E. Miscellaneous Record Submittals:

1. Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work.
2. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference.
3. Submit to the Engineer/Architect for the Owner's records.

## 1.5 OPERATING AND MAINTENANCE MANUAL INSTRUCTIONS

- A. Prior to Substantial Completion, the Contractor shall deliver to the Engineer/Architect one electronic copy of the operating and maintenance (O&M) manual; assembled and indexed; presenting for the Owner's guidance full details for care and maintenance of the general construction building items (automatic doors, elevators, flooring, roofs, etc.); and the fire protection, plumbing, HVAC, electrical, and other miscellaneous equipment included in Contract.
1. O&M manual shall be prepared using Adobe Acrobat software (Version 10 or later) to create electronic PDF files of the manual contents. Prepare the electronic O&M manual according to the following instructions.
    - a. Obtain original PDF files of O&M literature from subcontractors and vendors. Scanned copies of paper files are not acceptable.
      - 1) The O&M literature of the equipment shall include, but not be limited to, technical data of the equipment, wiring diagrams, routine maintenance instructions, and other information necessary for the proper operation of the equipment.
      - 2) Include the approved submittal for each item of equipment.
      - 3) Include a complete parts list for each item of equipment.
      - 4) Include MSDS sheets, if applicable, for each item of equipment.
      - 5) Include the name, address, and phone number of the nearest sales and service organization for each item.
    - b. Organize contents by CSI division.

- c. Name individual equipment O&M files by CSI division so that the individual files can be combined into a single PDF file. In doing so, Adobe Acrobat will automatically create “bookmarking” which will allow the Owner to search and navigate the O&M manual quickly and easily to find individual contents of the combined PDF file.
  - 1) Example: Two different types of pumps are specified in section “15185 HVAC Pumps” – the first is an end-suction centrifugal pump, and the second is a double-suction centrifugal pump. Each pump has different O&M instructions. As such, the individual file for the end-suction pump would be named “15185.01 End-Suction Pumps”, and the file for the double-suction pump would be named “15185.02 Double-Suction Pumps.”
- d. After the individual PDF files are created, the Contractor shall select all the individual files and combine them into a single file using the “Combine supported files in Acrobat” feature.
- e. The combined PDF file of the O&M manual shall be stored on a properly labeled compact disc for the project.

**B. Drawings:**

1. Where drawings or diagrams are required as part of the manual, provide original, legible PDF files of the drawings. .
2. Organize and name drawings so that they are assembled and indexed with the equipment O&M files they are associated with.

**C. Cover Page:**

1. Provide a cover page at the beginning of the O&M manual. Provide the following information:
  - a) Name of the Owner.
  - b) Name and address of the facility.
  - c) Name of project.
  - d) Date of O&M manual submittal.
  - e) Name, address, and telephone number of the General Contractor.
  - f) Name, address, and telephone number of the Architect/Engineer;

**D. Table of Contents:**

1. After the Cover Page, include a table of contents for the O&M manual, organized by CSI division and arranged systematically according to the Project Manual format. Include a list of each product identified by the product’s CSI division and name indexed to the content of the O&M manual.

**E. Project Team Report:**

1. Include a Project Team Report section immediately following the Table of Contents listing the name, address, and phone number of the General Contractor; and each subcontractor and/or vendor and the division of work for which they were responsible.

**F. Authorities Having Jurisdiction Approvals:**

1. Include an Authorities Having Jurisdiction (AHJ) Approvals section immediately following the Project Team Report that includes the Certificate(s) of Occupancy, Fire Marshal Inspection, and any other AHJ approval documents obtained for the project.
- G. Project Warranties:
1. Include a Project Warranties section immediately following the Authorities Having Jurisdiction Approvals that includes warranty letters from the General Contractor; and each subcontractor for the division of work for which they were responsible.
- H. Product Data (Divisions 2 through 16):
1. Include Product Data sections for each item of equipment immediately following the Project Warranties organized and tabulated by the product's CSI division. Provide a separate tabulated section for each CSI division of products.
  2. Where manufacturer's standard printed data is included in the O&M manual, include only sheets that are pertinent to the part or product installed.
  3. Mark each sheet to identify each part or product included in the installation.
  4. Where more than one item in a tabular format is included, identify each item, using appropriate references from the Contract Documents.
  5. Identify data that is applicable to the installation and delete references to information that is not applicable.
- I. Written Text:
1. Where manufacturer's standard printed data is not available, and information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement data included in the manual, prepare written text to provide necessary information.
  2. Organize the text in a consistent format under separate headings for different procedures.
  3. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure.
- J. Warranties, Bonds and Service Contracts:
1. Provide a copy of each warranty, bond or service contract in the General Information section of the O&M manual.
  2. Provide written data outlining procedures to be followed in the event of product failure.
  3. List circumstances and conditions that would affect validity of the warranty or bond.

## 1.6 INSTRUCTIONS

- A. The Owner's delegated representative shall be given personal instructions by trained personnel, in the care, use, maintenance, and operation procedures for each item.
1. This shall be done in accordance with, and in addition to, the above required manual.
- B. Operating and Maintenance Instructions:
1. Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance.
  2. If installers are not experienced in procedures, provide instruction by manufacturer's representatives.

3. Include a detailed review of the following items:
    - a) Maintenance manuals.
    - b) Record documents.
    - c) Spare parts and materials.
    - d) Tools.
    - e) Identification systems.
    - f) Control sequences.
  4. As part of instruction for operating equipment, demonstrate the following procedures:
    - a) Start-up.
    - b) Shutdown.
    - c) Emergency operations.
    - d) Noise and vibration adjustments.
    - e) Safety procedures.
    - f) Economy and efficiency adjustments.
    - g) Effective energy utilization.
- C. Maintenance Procedures:
1. Provide information detailing essential maintenance procedures, including the following:
    - a) Routine operations.
    - b) Trouble-shooting guide.
    - c) Disassembly, repair and re-assembly.
    - d) Alignment, adjusting and checking.
- D. Operating Procedures:
1. Provide information on equipment and system operating procedures, including the following:
    - a) Start-up procedures.
    - b) Equipment or system break-in.
    - c) Routine and normal operating instructions.
    - d) Regulation and control procedures.
    - e) Instructions on stopping.
    - f) Shutdown and emergency instructions.
    - g) Summer and winter operating instructions.
    - h) Required sequences for electric or electronic systems.
    - i) Special operating Instructions.
- E. Servicing Schedule:
1. Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.
- F. Controls:
1. Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.
- G. Coordination Drawings:
1. Provide each Contractor's Coordination Drawings.
  2. Provide as-installed color-coded piping diagrams, where required for identification.
- H. Valve Tags:

1. Provide charts of valve tag numbers, with the location and function of each valve.

**PART 2 - PRODUCTS** (Not Applicable)

**PART 3 - EXECUTION** (Not Applicable)

**END OF SECTION 01781**

**SECTION 01788 - WARRANTIES AND BONDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

A. Work Included This Section:

1. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.
2. Specific requirements for warranties for the Work and products and installations that are specified to be warranted are included in the individual Sections of Divisions 2 through 16.
3. Certifications and other commitments and agreements for continuing services to Owner are specified in the Contract Documents.

B. Disclaimers and Limitations:

1. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign warranties with the Contractor.
2. At no time shall any warranties/guarantees be submitted to the Owner for this project which supercedes or voids any of the Owners rights as established by the state's General Statutes for which the project is located.
3. Failure of the Contractor and/or its suppliers, manufacturers and its sub-contractors to enter into such warranties as required by the Contract Documents shall be considered a breach of contract.

**1.2 WARRANTY REQUIREMENTS**

A. Related Damages and Losses:

1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work. Do not reuse damaged materials.

**1.3 SUBMITTALS**

A. Written Warranties:

1. Submit written warranties to the Engineer/Architect prior to Substantial Completion in a separate three ring binder. The Engineer/Architect's Certificate of Substantial Completion designates a commencement date for warranties.
2. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or the Contractor and subcontractor, supplier or manufacturer.
3. Refer to individual Sections for specific content requirements, and particular requirements for submittal of special warranties.

B. Form of Submittal:

1. At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or

manufacturer. Organize the warranty documents into an orderly sequence based on the Table of Contents of the Project Manual. Deliver all warranties to the Engineer/Architect before or with the Request for Substantial Completion.

C. Reinstatement of Warranty:

1. When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
2. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

D. Replacement Cost:

1. Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents.
2. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of Work through a portion of its anticipated useful service life.

E. Owner's Recourse:

1. Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

F. Rejection of Warranties:

1. The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

**PART 2 - PRODUCTS** (Not Applicable)

**PART 3 - EXECUTION** (Not Applicable)

**END OF SECTION 01788**

SECTION 24119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PRE DEMOLITION MEETINGS

- A. Pre-demolition Conference: Conduct conference at the project site.

1.4 CLOSEOUT SUBMITTALS

- A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.5 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.6 FIELD CONDITIONS

- A. Other Tenants will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.



- D. Hazardous Materials: Hazardous materials are not believed to be in the within the basement work area. The following steps should be taken if presumed hazardous materials are uncovered.
  - 1. Advise Owner and Architect immediately if evidence of asbestos will be affected by new work.
  - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

### 1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  2. Arrange to shut off indicated utilities with utility companies.
  3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  4. Disconnect, demolish, and remove plumbing, and HVAC systems, equipment, and components indicated to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Comply with requirements for access and protection specified in Section 01500 "Temporary Facilities."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent Tenants, buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  5. Dispose of demolished items and materials promptly.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 24119

**FINAL**



## Asbestos and Lead Based Paint Survey Report

### Various County Owned Buildings

**Prepared For:**

*County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502*

**Prepared By**

*KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center  
II, Suite 220  
Raleigh, NC 27609  
KCI Job No: 15111236*

April 19, 2012



# **Asbestos and Lead Based Paint Survey Report**

of

## **Various County Owned Buildings**

**Prepared For:  
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4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236**

April 19, 2012

## Executive Summary

KCI Associates of North Carolina, P.A (KCI) was retained by Lenoir County to conduct Asbestos and Lead Based Paint Survey for 16 county-owned buildings located in Kinston, North Carolina. This report was prepared in accordance with KCI Proposal: Asbestos and Lead-Based Paint Surveys of Various County-Owned Buildings, dated November 9, 2011.

KCI conducted the asbestos survey of the county-owned buildings for suspect asbestos containing material (ACM). The survey included a detailed visual inspection of all accessible areas, assessment of potential inaccessible areas and sampling of suspect ACMs for laboratory analysis.

Based on the analytical results and the assumptions made during the survey, the following materials have been determined to be asbestos containing materials (ACM):

### Court House

- Approximately 150 square feet of boiler insulation on the exterior of the boiler and interior boiler materials including but not limited to gaskets, packings, caulking, refractory brick and mortar, located in the boiler room.
- Approximately 3,200 linear feet of pipe insulation and associated debris throughout the old building.
- Approximately 350 pipe fittings throughout the old building.
- Approximately 32,000 square feet of floor tile beneath 12 inch floor tile and carpet throughout the old building.
- Approximately 160 square feet of 9 inch floor tile and associated black mastic located in the 4<sup>th</sup> floor detention facility storage of the old building.
- Approximately 650 linear feet of window glazing on interior 8 windows throughout the old building.
- Assumed approximately 11,000 square feet of asbestos-containing 1x1 ceiling tile and associated mastic dots throughout the old building.
- Assumed asbestos-containing vibration dampers (unknown quantity) on all HVAC systems located throughout the building.
- Assumed 6 asbestos-containing fire door located in throughout the building.

### County Manager

- Assumed asbestos-containing vibration dampers (unknown quantity) on all HVAC systems located throughout the building.

### Cooperative Extension

- None

### Livestock Arena

- Assumed asbestos-containing roofing material located on roof.
- Assumed asbestos-containing vibration dampers (unknown quantity) on all HVAC systems located throughout the building.

### Elections/ABC Building

- Approximately 250 square feet of tan, 12 inch floor tile located throughout board of elections.
- Approximately 250 square feet of black floor tile mastic located throughout board of elections.
- Approximately 80 square feet of black floor tile mastic located throughout the ABC Warehouse.

- Approximately 950 square feet of tan and brown, 12 inch floor tile located throughout ABC Board offices.
- Approximately 950 square feet of black floor tile mastic located throughout ABC Board offices.
- Assumed asbestos-containing vibration dampers located throughout building.

#### Health Department

- Approximately 1,700 square feet of tan, 12 inch floor tile with brown streaks located on first floor north wing corridor 4, patient's area 1, 2, and 3, and throughout stairwells.
- Assumed 2 asbestos-containing fire door located in the boiler room.
- Approximately 12,800 square feet of (assumed) asbestos-containing roofing material located on the roof.

#### Social Services

- Approximately 40 square feet of beige, 9 inch floor tile and associated mastic located in Room 3 and stairwell of second floor.
- Approximately 2,250 square feet of black floor tile mastic located throughout the building.
- Approximately 1 fire door located in west wing of building.
- Assumed asbestos-containing roofing material located on roof.
- Assumed asbestos-containing vibration dampers located throughout the building.

#### Resource Development Building

- Approximately 1 square feet of white pipe insulation located in the boiler room.
- Approximately 350 linear feet of white pipe throughout the building.
- Approximately 50 pipe fittings throughout the building.
- Approximately 120 square feet of boiler insulation located in basement.
- Approximately 60 linear feet of door caulking located on all exterior doors.
- Joint compound applied over approximately 6,000 square feet of drywall throughout the building.
- Approximately 6,000 square feet of (assumed) asphalt roof shingles located on roof.
- Approximately 400 linear feet of (assumed) asbestos-containing window caulking located on exterior windows.
- Approximately 1,250 square feet of 9 inch floor tile (assumed) located throughout back section of the building.
- Approximately 1,250 square feet of black floor tile mastic (assumed) located throughout back section of the building.
- Assumed asbestos-containing interior boiler materials located in the basement.
- Assumed approximately 25 square feet of asbestos-containing gasket on the exterior of boiler located in the basement.

#### Nature Center and Education Building

- Approximately 3,750 square feet of (assumed) asbestos-containing built up roofing and associated mastics.
- Approximately 2,500 square feet of (assumed) asbestos-containing paint located on roof.
- Assumed asbestos-containing vibration dampers located throughout the building.

#### Planetarium

- Approximately 2,150 square feet of (assumed) asbestos-containing built up roofing and associated mastics.
- Assumed asbestos-containing vibration dampers located throughout the building.

### Old M.I.S Building

- Approximately 100 square feet of white boiler insulation located in the basement.
- Approximately 100 square feet of brown boiler insulation located in the basement.
- Approximately 50 pipe fittings throughout the building.
- Approximately 400 linear feet of pipe wrap located throughout the building.
- Approximately 400 linear feet of pipe insulation throughout the building.
- Approximately 40 square feet of tank insulation located in the basement.
- Approximately 2 square feet of tank wrap located in the basement.
- Approximately 50 linear feet of door caulking located on all exterior doors.
- Approximately 270 square feet of black floor tile mastic located throughout the building.
- Approximately 2,150 square feet of (assumed) asphalt roof shingles located on the roof.

### Tax Office

- Approximately 9,000 square feet of off white, 12 inch floor tile located throughout the building.
- Approximately 9,000 square feet of black floor tile mastic located throughout the building.
- Assumed asbestos-containing roofing material located on roof.
- Approximately 1 door with asbestos-containing caulking located in mechanical room.
- Approximately 3 asbestos-containing fire doors located in mechanical room and room 38.

### EMS Station #1

- Approximately 170 square feet of beige, 12 inch floor tile throughout the building.
- Approximately 170 square feet of black floor tile mastic throughout the building.
- Approximately 324 square feet of white and beige, 12 inch floor tile throughout the building.
- Approximately 170 square feet of black floor tile mastic throughout the building.
- Approximately 4,000 square feet of (assumed) asbestos-containing roofing and associated mastics.
- Assumed asbestos-containing vibration dampers located throughout the building.

### Hannibal Building

- Joint compound applied over approximately 12,000 square feet of located throughout building.

### Landfill Scale House

- Approximately 25 square feet of black roof penetration mastic located on roof.
- Approximately 1,500 square feet of (assumed) asphalt roof shingles located on roof.
- Assumed asbestos-containing vibration dampers located throughout building.

### Landfill Maintenance Building

- Approximately 2,750 square feet of (assumed) paint coating located on roof.

KCI conducted a Lead Based Paint (LBP) screening of representative areas. This survey identified LBP on the following surfaces:

### Court House

- Gray ceramic tiles located on the walls of attorney office and 4<sup>th</sup> floor jail.
- Metal window frames and window components painted brown located throughout the main lobby.



County Manager

- Brick and wood walls painted white located inside of fire station museum and maintenance shop.
- Plaster walls painted light green in the maintenance shop.
- Wood door frames and door components painted cream in the hallway of Teen Court and County Manager office. A total of two doors were found to be positive.
- Wood door frames and door components painted green located on exterior of building. A total of four green wooden doors were found to be positive.
- Red brick walls located on exterior of building.

Cooperative Extension

- None

Live Stock Arena

- None

Elections/ABC Building

- None

Health Department

- None

Social Services

- None

Resource Development

- None

Nature Center and Education Building

- None

Planetarium

- None

Old M.I.S. Building

- Walls, doors, door frames and door components, window frames and window components, and radiators painted white located throughout the house. A total of three radiators located throughout house contain lead based paint.
- Black and white bathroom wall tiles, fire place tiles, and sinks contain lead.
- Door frames and door components and window frames and window components painted white located on exterior of house. A total of eighteen wood windows and two wooden doors were found positive.

Tax Office

- None

EMS Station#1

- None

Hannibal Building

- None

Landfill Scale House

- None

Landfill Maintenance Building

- None

***Recommendations:***

Asbestos

KCI recommends that Lenoir County develop and implement an Operation and Maintenance (O&M) plan for properly managing ACM in the 16 surveyed County owned buildings to assure compliance with regulations.

As a part of the O&M plan KCI recommends that Lenoir County perform the following:

1. Provide asbestos awareness training to the maintenance and custodial staff.
2. Perform periodic surveillance at least once a year of all the identified ACM in good condition to monitor for changes in its condition.
3. In buildings where accessible friable ACM is in damaged condition, KCI recommends that those areas be restricted until a response action is performed. The response action may include abating (removing) ACM material, repairing or encapsulating it.

Lead Based Paint

KCI recommends that the building components with lead paint be maintained such that there is no peeling, chipping or flaking paint.

During the renovation /demolition of any building component with LBP, KCI recommends that the contractor should follow OSHA "Lead in Construction" standard, in conjunction with dust control and containment to prevent lead contamination of the surrounding areas, and the use of personal protective clothing to protect worker health and safety.

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## Appendices

- Appendix A: Accreditation Credential Certificates  
Appendix B: Building Floor Plans, Chain Of Custody Forms, Certificate Of Analysis Forms And Lead Based Paint Datasheets And Field Photographs For Each Building.

## 1.0 Introduction

KCI Associates of North Carolina, P.A (KCI) was retained by County of Lenoir to conduct an Asbestos and Lead Based Paint Survey for 16 County owned buildings located in Kinston, North Carolina. This report was prepared in accordance with KCI Proposal: Asbestos and Lead-Based Paint Surveys of Various County-Owned Buildings, dated November 9, 2011.

The Scope of Work (SOW) included: 1) visual observations of the building and property; (2) bulk sampling and analysis and quantification of suspect asbestos-containing materials; (3) analysis of selected painted surfaces for the presence of lead; (4) label posting of all asbestos and lead based paint areas (5) and generation of this report documenting the findings.

### 1.1 Site Description

KCI conducted the Asbestos and Lead Based Paint Survey for various County-Owned buildings in Kinston, NC from January 9<sup>th</sup> – January 17<sup>th</sup> 2011. Lenoir County's buildings consist of 16 buildings located in various locations throughout Kinston, North Carolina.

## 2.0 Accreditation Credentials

The following KCI representatives performed the asbestos survey of the subject site:

- Ms. Davida Jones: EPA-AHERA asbestos building inspector Certification #115994
- Ms. Tehsin Aurangabadwala: EPA-AHERA asbestos building inspector Certification # 91395
- Ms. Tehsin Aurangabadwala: NC Asbestos Accreditation # 91185

The copies of the accreditation certificates are included in Appendix A.

## 3.0 Health Effects

### Asbestos Exposure

Asbestos is a mineral fiber that was extensively used in various building and construction materials before its ban in 1972. Asbestos may be found in thermal insulation on pipes and boilers, wallboards, ceiling tiles, floor tiles, acoustical plaster, fireproofing textiles, roofing materials and other materials.

Asbestos fibers, if inhaled or ingested, can cause diseases related to respiratory and digestive systems. The inhaled fibers can migrate into the lung and become embedded in the lung tissues. Asbestos can cause lung cancer, mesothelioma (a cancer of the chest and abdominal linings), and asbestosis (irreversible lung scarring that can be fatal). The ingested asbestos fibers can cause cancer in digestive system (esophageal, stomach colon and rectal). Symptoms of these diseases do not show up until many years (approximately 10-40 years) after the initial exposure. Smoking increases the risk of developing asbestos-induced lung cancer.

### Lead Exposure

Lead-contaminated dust, particularly from old paint, is the most significant source of lead exposure for children. Common renovation activities like sanding, cutting and demolition can create hazardous lead dust and chips by disturbing lead-based paint. Lead poisoning can affect nearly every system in the body,

but it often occurs with no obvious symptoms. Lead poisoning in children can cause learning disabilities, behavioral problems, and at very high levels, seizures, coma, and even death.

#### 4.0 Asbestos Survey Methodology

KCI's representatives conducted the ACM survey of the subject site from January 9<sup>th</sup> to January 17<sup>th</sup> 2011. The scope of work included a visual evaluation of potential ACMs and the collection of bulk samples of these materials. The following sections describe the methodology used during the asbestos inspection.

#### 4.1 Visual Inspection and Assessment of Asbestos Containing Materials

A visual inspection of the friable and non-friable known or assumed asbestos containing materials (ACM) for the subject site was performed. KCI located and listed all homogenous areas of material that are suspected to contain asbestos. A homogenous area is an area of surfacing material, thermal system insulation, or miscellaneous material that is uniform in color and texture. The interior materials suspected of containing asbestos were categorized as one of the following three types:

- Surfacing Materials: The building materials that are sprayed-on, troweled-on, or otherwise applied to surfaces such as ceiling plaster, and sprayed-on fireproofing.
- Thermal System Insulations (TSI): The building materials applied to pipes, fittings, boilers, breeching, tanks, ducts, or other interior structural components to prevent heat loss or gain such as insulation wrapped on ducts or pipes.
- Miscellaneous Materials: The building materials on structural components that do not include surfacing material or TSI such as floor tiles or ceiling tiles.

A physical assessment of the suspect material was performed and the suspect material was placed in one of the three categories based on visual inspection.

- Good: These are the materials which are intact and in good condition.
- Damaged: These materials correspond to the damaged categories in the 763.88 AHERA Rule.
- Significantly Damaged: These materials correspond to the significantly damaged categories in the 763.88 AHERA Rule.

#### 4.2 Methodology of Sampling and Analysis

KCI's building inspector(s) performed sampling following the AHERA regulation. Bulk samples of the suspect ACMs were collected using a metal utility knife that was driven through the suspect material to the substrate in order to obtain a sample containing all discrete layers. The samples were then placed in re-sealable plastic bags and assigned unique identifiers that were recorded on the bags and on the bulk survey sampling sheets. The suspect asbestos bulk samples collected by KCI's building inspector were submitted, along with a chain-of-custody form to Scientific Analytical Institute, Inc. (SAI) located in Greensboro, North Carolina. SAI is accredited by the American Industrial Hygiene Association, AIHA #173190, and National Institute of Standards and Technology through the National Voluntary Laboratory Accreditation Program (NVLAP) for Bulk Asbestos Analysis, NVLAP # 200664-0. The chain-of-custody form is included in Appendix B.

The method used for analyzing the bulk samples was Polarized Light Microscopy (PLM). PLM is an optical microscopic technique that distinguishes the different types of asbestos fibers by their shape and unique optical properties. The technique is based on the refraction of light from various crystalline asbestos structures and the observation of the corresponding color changes through the microscope. All PLM analysis was performed following the methodologies documented in the EPA method 600/R-93/116, July 1993, "Method for the Determination of Asbestos in Bulk Building Materials".

The EPA defines an asbestos containing material as "any material containing greater than one percent asbestos as determined using the method specified in appendix A, subpart F, 40 CFR part 763, section 1, PLM."

#### Positive Stop Procedures for PLM analysis

In accordance with U.S. EPA guidelines, samples are categorized into "homogeneous groups" by material type. The number of samples to be taken for each group is dictated by the type and quantity of the material. All samples within the homogeneous group must be less than 1% asbestos in order to classify the material as "non-asbestos." Conversely, the positive result of any one (1) sample dictates that the homogeneous group be classified as ACM. Thus, when the individual samples of each homogeneous group are analyzed, the laboratory will discontinue analysis when asbestos has been identified in one (1) of the samples. These subsequent samples, which have not yet been analyzed, are reported as PS ("Positive Stop") and the homogeneous material is classified as an ACM.

### **5.0 Lead Based Paint (LBP) Screening**

KCI's Lead Inspector performed a LBP screening of the subject site in order to generally characterize interior and exterior painted surfaces for lead content. The following painted structures were surveyed for LBP: doors, door components, window components, walls, baseboards, support beams, and bathroom fixtures.

The testing for lead content in paints was performed with Thermo Scientific Niton XLp (model # XLp 300) x-ray fluorescence (XRF) Spectrum Analyzer, an instrument that detects lead by reading the fluorescence emanating from a painted surface when exposed to small amounts of radiation. XRF readings are in mg/cm<sup>2</sup>, a mass per area reading. LBP is defined as paint or other surface coatings that contain lead equal to or greater than 1.0 mg/cm<sup>2</sup> by the Environmental Protection Agency (40 Code of Federal Regulations § 745.223) and the U. S. Dept. of Housing and Urban Development (HUD).

### **6.0 Survey Findings**

The findings from the Asbestos Survey associated with the subject site are described in the section(s) below. The analytical results of the bulk samples collected from each building are summarized in the Analytical Results Table(s) below. The Homogenous Materials Summary Table(s) provided below presents ACM's grouped into homogenous material categories. The Homogenous Material Summary Table(s) describes each homogenous material category in terms of: material ID, material category/description, units of measurement and quantity, and the condition of the ACM.

A building floor plan, ACM bulk sample datasheet, and certificate of analysis for each building is provided in Appendix B.

**6.1 (A) COURT HOUSE**

A total of 91 bulk samples were collected from Court House.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

<b>Table 6.1.1: Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Approx. Quantity</b>
<b>THERMAL SYSTEM INSULATION</b>						
Boiler Insulation (exterior)	Boiler Room	A-1, A-2, A-3	20% C, PS, PS	Damaged	Friable	150 SF
Pipe Insulation and associated debris	Throughout the old building in accessible areas including boiler room/crawlspace and inaccessible areas including wall chases and fixed ceiling	A-4, A-5, A-6	50% C, PS, PS	Damaged	Friable	3,200 LF
Pipe Fitting Insulation and associated debris	Throughout the old building in accessible areas including boiler room/crawlspace and inaccessible areas including wall chases and fixed ceiling	A-7, A-8, A-9	30% C PS, PS	Damaged	Friable	350 Each
<b>SURFACING</b>						
Plaster – base	Throughout old building	A-20, A-21, A-22, A-38, A-39, A-44, A-45	All NAD	Good	N/A	N/A
Plaster – skim	Throughout old building	A-17, A-18, A-19, A-36, A-37, A-42, A-43	All NAD	Good	N/A	N/A
Spray on Material	Throughout new building on beams	A-52, A-53, A-54, A-55, A-56	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
Caulk – grey	Throughout the building on interior and exterior walls	A-76, A-77, A-80, A-81, A-88, A-89	All NAD	Good	N/A	N/A
Caulk –white	Glass window (entire wall) across main lobby entrance	A-78, A-79, A-90 A-91	All NAD	Good	N/A	N/A
2x4 Ceiling Tile	Throughout the building	A-11, A-12	All NAD	Good	N/A	N/A
1x1 Ceiling Tile	Throughout the building	Not Sampled	Assumed	Good	Friable	11,000 SF
Covebase – black	Throughout the building	A-46, A-47	All NAD	Good	N/A	N/A
Covebase – light blue	Throughout the building	A-23, A-24	All NAD	Good	N/A	N/A

<b>Table 6.1.1: Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Approx. Quantity</b>
Covebase – white	Throughout the building	A-63, A-64	All NAD	Good	N/A	N/A
Drywall – brown	Throughout the building	A-65,A-66	All NAD	Good	N/A	N/A
Drywall – white	Throughout the building	A-33, A-34, A-61, A-62	All NAD	Good	N/A	N/A
Joint Compound	Throughout the building	A-33a, A-34a	All NAD	Good	N/A	N/A
Duct Seam Sealant – beige	Throughout the building	A-40, A-41	All NAD	Good	N/A	N/A
Floor Tile	Throughout the old building below the 12” floor tiles and carpet	A-31, A-32	3%C, PS	Good	Category I non friable	32,000 SF
9” Floor Tile and black mastic	Old building – 4 <sup>th</sup> floor detention facility storage	Not Sampled	Assumed	Good	Category I non friable	160 SF
12” Floor Tile – brown w/ grey specs	Throughout the building	A-27, A-28	All NAD	Good	N/A	N/A
12” Floor Tile – brown w/ yellow streaks	Throughout the building	A-57, A-58	All NAD	Good	N/A	N/A
12” Floor Tile – grey w/ black specs	Throughout the building	A-68, A-69	All NAD	Good	N/A	N/A
12” Floor Tile – white	Throughout the building	A-13, A-14	All NAD	Good	N/A	N/A
Glaze – black	Throughout the building	A-74, A-75	All NAD	Good	N/A	N/A
Mastic – black	Throughout the building beneath floor tiles	A-15, A-16, A-29, A-30	All NAD	Good	N/A	N/A
Mastic – tan	Throughout the building behind covebase	A-25, A-26	All NAD	Good	N/A	N/A
Mastic – yellow	Throughout the building behind covebase	A-48, A-49,	All NAD	Good	N/A	N/A
Mastic – yellow	Throughout the building beneath carpet	A-50, A-51, A-59, A-60, A-67	All NAD	Good	N/A	N/A
Mastic Dots	Throughout the building on 1x1 ceiling tiles	Not Sampled	Assumed	Unknown	Category II non friable	Applied over 11,000 SF of ceiling area
Terrazzo Flooring – tan and pink	Throughout hallways in the old building	A-86, A-87	All NAD	Good	N/A	N/A



<b>Table 6.1.1: Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Approx. Quantity</b>
Terrazzo – orange	Throughout hallway walls in the new building	A-82, A-83	All NAD	Good	N/A	N/A
Terrazzo – black	Throughout hallways/stairways in the old building	A-84, A-85	All NAD	Good	N/A	N/A
Window Glazing – grey	Throughout the old building – interior windows	A-70, A-71	PS, 3%C	Good	Category I non friable	650 LF
Window Caulk – grey	Throughout the old building – interior windows	A-72, A-73	All NAD	Good	N/A	N/A
Vibration Dampers	On all HVAC system and connections	Not Sampled	Assumed	Unknown	Category II non friable	Unknown
Interior Boiler Materials – (refractory brick & mortar, packings, gaskets, caulking, etc.)	Boiler Room	Not Sampled	Assumed	Unknown	Category I non friable	Unknown
Fire Doors	Throughout the building	Not Sampled	Assumed	Good	Category II non friable	6 Each
<p>Notes:                      C – Chrysotile Fiber    NAD – No Asbestos Detected    SF – Square Feet    LF – Linear Feet                      N/A – Non-Applicable    PS – Positive Stop Rule for Analyzing Samples</p> <p>KCI reviewed documentation provided by the Lenoir County for the roofing material. The roofing material consists of Thermoplastic PVC Elvaloy system with silicone caulking. Based on this information KCI has excluded the roofing material as a suspect ACM, however, KCI recommends testing the roofing material prior to any disturbance, renovation or demolition of the roof.</p>						

The analytical results table describes the suspect material sampled, location of sampling, type of homogenous category and laboratory results.

<b>Table 6.1.2: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
A-1	Boiler insulation	Boiler room	TSI	20% Chrysotile
A-2	Boiler insulation	Boiler room	TSI	Positive Stop
A-3	Boiler insulation	Boiler room	TSI	Positive Stop
A-4	Pipe insulation	Boiler room 6" pipe	TSI	50% Chrysotile
A-5	Pipe insulation	Boiler room 6" pipe	TSI	Positive Stop
A-6	Pipe insulation	Boiler room 6" pipe	TSI	Positive Stop
A-7	Pipe fitting insulation	Boiler room 6" pipe	TSI	30% Chrysotile
A-8	Pipe fitting insulation	Boiler room 6" pipe	TSI	Positive Stop
A-9	Pipe fitting insulation	Boiler room 6" pipe	TSI	Positive Stop
A-11	2x4 Ceiling tile	Basement room 1 women's rest room	Miscellaneous	NAD

**Table 6.1.2: Analytical Results Table**

Sample No	Material Description	Sample Location	Material Type	Results
A-12	2x4 Ceiling tile	Basement corridor 1	Miscellaneous	NAD
A-13	12" Floor tile – white	Basement sheriff room 7	Miscellaneous	NAD
A-14	12" Floor tile – white	Basement sheriff room 7	Miscellaneous	NAD
A-15	Mastic – black	Beneath a-13	Miscellaneous	NAD
A-16	Mastic – black	Beneath a-14	Miscellaneous	NAD
A-17	Plaster skim	Basement room 8	Surfacing	NAD
A-18	Plaster skim	Basement room 8	Surfacing	NAD
A-19	Plaster skim	Basement room 8	Surfacing	NAD
A-20	Plaster base	Basement room 8	Surfacing	NAD
A-21	Plaster base	Basement room 8	Surfacing	NAD
A-22	Plaster base	Basement room 8	Surfacing	NAD
A-23	Covebase – light blue	Basement room 8	Miscellaneous	NAD
A-24	Covebase – light blue	Basement room 8	Miscellaneous	NAD
A-25	Mastic – tan	Behind A-23	Miscellaneous	NAD
A-26	Mastic – tan	Behind A-24	Miscellaneous	NAD
A-27	12" Floor tile – brown w/ grey specs	Basement room 8	Miscellaneous	NAD
A-28	12" Floor tile – brown w/ grey specs	Basement room 8	Miscellaneous	NAD
A-29	Mastic – black	Beneath sample A-27	Miscellaneous	NAD
A-30	Mastic – black	Beneath sample A-28	Miscellaneous	NAD
A-31	Floor tile (2nd layer)	Beneath Sample A-27	Miscellaneous	3% Chrysotile
A-32	Floor tile (2nd layer)	Beneath Sample A-28	Miscellaneous	Positive Stop
A-33	Drywall - white	Basement room 11	Miscellaneous	NAD
A-33a	Joint compound	Basement room 11	Miscellaneous	NAD
A-34	Drywall - white	Basement room 11	Miscellaneous	NAD
A-34a	Joint compound	Basement room 11	Miscellaneous	NAD
A-36	Plaster skim	Basement room 11 ceiling	Surfacing	NAD
A-37	Plaster skim	Basement room 11 ceiling	Surfacing	NAD
A-38	Plaster base	Basement room 11 ceiling	Surfacing	NAD
A-39	Plaster base	Basement room 11 ceiling	Surfacing	NAD
A-40	Duct seam sealant – beige	Basement room 11 ceiling	Miscellaneous	NAD
A-41	Duct seam sealant – beige	Basement room 11 ceiling	Miscellaneous	NAD
A-42	Plaster skim	Basement – mechanical room	Surfacing	NAD
A-43	Plaster skim	Basement – mechanical room	Surfacing	NAD
A-44	Plaster base	Basement – mechanical room	Surfacing	NAD
A-45	Plaster base	Basement – mechanical room	Surfacing	NAD
A-46	Covebase – black	Basement room 17	Miscellaneous	NAD
A-47	Covebase – black	Basement room 17	Miscellaneous	NAD
A-48	Mastic – yellow	Basement room 17 behind covebase	Miscellaneous	NAD
A-49	Mastic – yellow	Basement room 17 behind covebase	Miscellaneous	NAD
A-50	Mastic – yellow	Basement room 17 behind covebase	Miscellaneous	NAD
A-51	Mastic – yellow	Basement room 17 beneath carpet	Miscellaneous	NAD

**Table 6.1.2: Analytical Results Table**

Sample No	Material Description	Sample Location	Material Type	Results
A-52	Spray on material	On beams – basement sally part	Surfacing	NAD
A-53	Spray on material	On beams – basement sally part	Surfacing	NAD
A-54	Spray on material	On beams – basement sally part	Surfacing	NAD
A-55	Spray on material	On beams – basement sally part	Surfacing	NAD
A-56	Spray on material	On beams – basement sally part	Surfacing	NAD
A-57	12" Floor tile – brown w/ yellow streaks	1st floor room 24	Miscellaneous	NAD
A-58	12" Floor tile – brown w/ yellow streaks	1st floor room 24	Miscellaneous	NAD
A-59	Mastic – yellow	Beneath carpet 1st floor district attorney room	Miscellaneous	NAD
A-60	Mastic – yellow	Beneath carpet 1st floor district attorney room	Miscellaneous	NAD
A-61	Drywall - white	1st floor civil court	Miscellaneous	NAD
A-62	Drywall - white	1st floor criminal court	Miscellaneous	NAD
A-63	Covebase – white	1st floor finance department	Miscellaneous	NAD
A-64	Covebase – white	1st floor finance department	Miscellaneous	NAD
A-65	Drywall – brown	1st floor finance storage rest room	Miscellaneous	NAD
A-66	Drywall – brown	1st floor finance storage rest room	Miscellaneous	NAD
A-67	Mastic – yellow	Below carpet 1st floor civil court	Miscellaneous	NAD
A-68	12" floor tile – grey w/ black specs	4th floor storage room	Miscellaneous	NAD
A-69	12" floor tile – grey w/ black specs	4th floor storage room	Miscellaneous	NAD
A-70	Window glazing – grey	Main lobby – 1st floor (interior window)	Miscellaneous	3% Chrysotile
A-71	Window glazing – grey	Main lobby – 1st floor (interior window)	Miscellaneous	Positive Stop
A-72	Window caulk – grey	Main lobby – 1st floor (interior window)	Miscellaneous	NAD
A-73	Window caulk – grey	Main lobby – 1 <sup>st</sup> floor (interior window)	Miscellaneous	NAD
A-74	Glaze – black	Main entrance door to lobby	Miscellaneous	NAD
A-75	Glaze – black	Main entrance door to lobby	Miscellaneous	NAD
A-76	Caulk – grey	On walls between concrete blocks main lobby (old)	Miscellaneous	NAD
A-77	Caulk – grey	On walls between concrete blocks main lobby (old)	Miscellaneous	NAD
A-78	Caulk – white	Exterior wall (glass) across main entrance – lobby	Miscellaneous	NAD
A-79	Caulk – white	Exterior wall (glass) across main entrance – lobby	Miscellaneous	NAD

Sample No	Material Description	Sample Location	Material Type	Results
A-80	Caulk – grey	On walls between concrete blocks main lobby (new)	Miscellaneous	NAD
A-81	Caulk – grey	On walls between concrete blocks main lobby (new)	Miscellaneous	NAD
A-82	Terrazzo – orange	1 <sup>st</sup> floor main lobby on walls (new)	Miscellaneous	NAD
A-83	Terrazzo – orange	1 <sup>st</sup> floor main lobby on walls (new)	Miscellaneous	NAD
A-84	Terrazzo – black	1 <sup>st</sup> floor – south hallway stairs	Miscellaneous	NAD
A-85	Terrazzo – black	1 <sup>st</sup> floor – south hallway stairs	Miscellaneous	NAD
A-86	Terrazzo – tan and pink	1 <sup>st</sup> floor north hallway	Miscellaneous	NAD
A-87	Terrazzo – tan and pink	1 <sup>st</sup> floor north hallway	Miscellaneous	NAD
A-88	Caulk – grey	Exterior walls between concrete blocks	Miscellaneous	NAD
A-89	Caulk – grey	Exterior walls between concrete blocks	Miscellaneous	NAD
A-90	Caulk – white	Exterior stairs	Miscellaneous	NAD
A-91	Caulk – white	Exterior stairs	Miscellaneous	NAD

Notes:  
NAD- No Asbestos Detected    TSI- Thermal System Insulation    Positive Stop – Rule for Analyzing Samples

KCI was not able to inspect the evidence rooms located in the Court House and has assumed those office areas to be similar to the adjacent rooms as described by the Lenoir County representative Mr. Mike Wiggins.

The Lead Based Paint screening for the Court House included 89 XRF readings. Table 6.1.3 summarizes the positive results of the LBP screening. The lead based paint datasheets are included as Appendix B.

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading (mg/cm <sup>2</sup> )	LBP (Y or N)
A-73	Ceramic	Tile	Gray	Hallway of attorney office 4th floor (top jail)	3.5	Yes
A-85	Metal	Window frame	Brown	Main lobby - 1	1.5	Yes
A-86	Metal	Window frame	Brown	Main lobby close to south end	1.3	Yes

Based on the results of the LBP screening, it was determined that the following surfaces in the Court House Building contain LBP:

- Gray ceramic tiles located on the walls of attorney office and 4<sup>th</sup> floor jail.
- Metal window frames and window components painted brown located throughout the main lobby.

A total of eight brown metal window frames located in the main lobby contain lead based paint. All painted surfaces containing lead were found to be in good condition.

**6.2 (B) COUNTY MANAGER**

A total of 23 bulk samples were collected from County Manager.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

<b>Table 6.2.1: Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Approx. Quantity</b>
<b>SURFACING</b>						
Plaster – base	Throughout the building	B-8, B-10, B-12	All NAD	Good	N/A	N/A
Plaster – skim	Throughout the building	B-7, B-9, B-11	All NAD	Good	N/A	N/A
Plaster – popcorn	Throughout the building	B-13, B-14, B-15, B-20, B-21	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
2x2 Ceiling Tile	County Manager Storage Closet	B-22, B-23	All NAD	Good	N/A	N/A
Drywall/ Joint Compound	Throughout the building	B-1, B-2, B-16 B-17	All NAD	Good	N/A	N/A
Linoleum Flooring	Throughout the building	B-3, B-4, B-5 B-6, B-18, B-19	All NAD	Good	N/A	N/A
Vibration Dampers	On all HVAC system and connections	Assumed	Assumed	Unknown	Category II non friable	Unknown
Notes:						
NAD – No Asbestos Detected    N/A – Non-Applicable						
KCI was informed by the Lenoir County that the roofing material consists of rubber system. Based on this information KCI has excluded the roofing material as a suspect ACBM, however, KCI recommends testing the roofing material prior to any disturbance, renovation or demolition of the roof.						

The analytical results table describes the suspect material sampled, location of sampling, type of homogenous category and laboratory results.

<b>Table 6.2.2: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
B-1	Drywall/joint compound	Fire station museum	Miscellaneous	NAD
B-2	Drywall/joint compound	Fire station museum	Miscellaneous	NAD
B-3	Linoleum flooring	Fire station museum bathroom	Miscellaneous	NAD
B-4	Linoleum flooring	Fire station museum bathroom	Miscellaneous	NAD
B-5	Linoleum flooring	Maintenance shop bathroom	Miscellaneous	NAD
B-6	Linoleum flooring	Maintenance shop bathroom	Miscellaneous	NAD
B-7	Plaster – skim	Maintenance shop bathroom	Surfacing	NAD
B-8	Plaster – base	Maintenance shop bathroom	Surfacing	NAD
B-9	Plaster – skim	Maintenance shop bathroom	Surfacing	NAD
B-10	Plaster – base	Maintenance shop bathroom	Surfacing	NAD
B-11	Plaster – skim	Maintenance Shop – entrance office	Surfacing	NAD

**Table 6.2.2: Analytical Results Table**

Sample No	Material Description	Sample Location	Material Type	Results
B-12	Plaster – base	Maintenance Shop – entrance office	Surfacing	NAD
B-13	Plaster – popcorn	Teen court asst. District attorney lobby ceiling	Surfacing	NAD
B-14	Plaster – popcorn	Teen court asst. District attorney kitchen ceiling	Surfacing	NAD
B-15	Plaster – popcorn	Teen court asst. District attorney bathroom ceiling	Surfacing	NAD
B-16	Drywall/joint compound	Teen court – kitchen	Miscellaneous	NAD
B-17	Drywall/joint compound	Teen court – storage room	Miscellaneous	NAD
B-18	Linoleum flooring	Teen court – restroom	Miscellaneous	NAD
B-19	Linoleum flooring	Teen court – restroom	Miscellaneous	NAD
B-20	Plaster – popcorn	County Manager Office – restroom	Surfacing	NAD
B-21	Plaster – popcorn	County Manager Office – restroom	Surfacing	NAD
B-22	2x2 Ceiling tile	County manager office storage closet	Miscellaneous	NAD
B-23	2x2 Ceiling tile	County manager office storage closet	Miscellaneous	NAD

Notes: NAD- No Asbestos Detected

KCI was not able to inspect Office 2 and Office 3 located in the Teen Court and Asst. District Attorney area and has assumed those office areas to be similar as Office 1 as described by the Lenoir County representative Mr. Mike Wiggins.

The Lead Based Paint screening included 53 XRF readings. Table 6.2.3 summarizes the positive results of the LBP screening. The lead based paint datasheets are included as Appendix B.

**Table 6.2.3: Summary of Positive XRF Results**

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading (mg/cm <sup>2</sup> )	LBP (Y or N)
B-12	Brick	Wall d	White	Closet (fire station)	5.7	yes
B-13	Wood	Wall a	White	Closet (fire station)	1.6	yes
B-18	Plaster	Wall a	Light green	Main entrance of maintenance shop	0.8	yes
B-20	Plaster	Wall c	Light green	Facing room 2 of maintenance shop	0.8	yes
B-27	Brick	Wall b	White	Bathroom of maintenance shop	2.1	yes
B-28	Plaster	Wall a	White	Bathroom of maintenance shop	0.8	yes
B-30	Wood	Door	Green	Exterior of main entrance	1.7	yes
B-31	Brick	Wall	Red	Exterior of main entrance	3.5	yes
B-41	Brick	Wall d	Cream	Hallway between teen court and county manager	3.4	yes
B-44	Wood	Door frame	Cream	Hallway between teen court and county manager	3.6	yes

Note: Wall A in a room faces the street address of the property (facing the road), Walls B, C and D follows in clockwise direction respectively.

Based on the results of the LBP screening, it was determined that the following surfaces in the County Manager Building contain LBP:

- Brick and wood walls painted white located inside of fire station museum and maintenance shop.
- Plaster walls painted light green in the maintenance shop.
- Wood door frames and door components painted cream in the hallway of Teen Court and County Manager office. A total of two doors were found to be positive.
- Wood door frames and door components painted green located on exterior of building. A total of four green wooden doors were found to be positive.
- Red brick walls located on exterior of building.

All painted surfaces containing lead were found to be in good condition.

### 6.3 (C) COOPERATIVE EXTENSION

A total of 36 bulk samples were collected from The Lenoir County Cooperative Extension Building. The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

Table 6.3.1. Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
<b>SURFACING</b>						
Spray on Ceiling – popcorn texture, white	Throughout Building	C-15,C-16,C-17, C-18,C-19,C-20, C-21, C-22	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
Carpet Mastic – yellow	Throughout the building, under carpet	C-1, C-2	All NAD	Good	N/A	N/A
Rubber Cover Base – grey	Throughout the building	C-3a, C-4a	All NAD	Good	N/A	N/A
Cove Base Mastic – yellow	Throughout the building, behind rubber covebase	C-3b, C-4b	All NAD	Good	N/A	N/A
12” Floor Tile – blue	Back door between room 16 and 17	C-5a, C-6a	All NAD	Good	N/A	N/A
Floor tile Mastic – yellow	Back door between room 16 and 17 under blue patterned floor tile	C-5b, C-6b	All NAD	Good	N/A	N/A
12” Floor tile – grey/blue	Room 7A	C-7, C-8	All NAD	Good	N/A	N/A
Drywall/Joint Compound	Throughout Building	C-9, C-10	All NAD	Good	N/A	N/A
Paper Cover on Fiberglass insulation	Throughout building	C-11, C-12	All NAD	Good	N/A	N/A
12” Floor Tile – beige/grey	Room 5A and Hallway 3	C-13a, C-14a	All NAD	Good	N/A	N/A

<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
Floor tile mastic – yellow	Room 5A and Hallway 3 under 12 inch tile	C-13b, C-14b	All NAD	Good	N/A	N/A
2x4 Ceiling tile – white, dot pattern	Room 7A	C-23, C-24	All NAD	Good	N/A	N/A
2x2 Ceiling tile – white worm hole pattern	Room 1 Auditorium	C-25, C-26	All NAD	Good	N/A	N/A
Door Caulking – brown	All exterior doors	C-27, C-28	All NAD	Good	N/A	N/A
Window Caulking – grey/brown	All exterior windows	C-29, C-30	All NAD	Good	N/A	N/A
Notes: NAD – No Asbestos Detected N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, type of homogenous category and laboratory results.

<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
C-1	Carpet mastic – yellow, under multi-color carpet	Room 7	Miscellaneous	NAD
C-2	Carpet mastic – yellow, under multi-color carpet	Hallway 4, outside room 10	Miscellaneous	NAD
C-3a	Rubber cove base – grey	Room 9	Miscellaneous	NAD
C-3b	Cove base mastic – cream	Room 9	Miscellaneous	NAD
C-4a	Rubber cove base – grey	Hallway 4	Miscellaneous	NAD
C-4b	Cove base mastic – cream	Hallway 4	Miscellaneous	NAD
C-5a	12” Floor tile – blue	South exit, outside room 16	Miscellaneous	NAD
C-5b	Floor tile mastic – yellow	South exit, outside room 16	Miscellaneous	NAD
C-6a	12” Floor tile – blue	South exit, outside room 16	Miscellaneous	NAD
C-6b	Floor tile mastic – yellow	South exit, outside room 16	Miscellaneous	NAD
C-7	12” Floor tile – grey/blue	Room 7a	Miscellaneous	NAD
C-8	12” Floor tile – grey/blue	Room 7a	Miscellaneous	NAD
C-9	Drywall/joint compound	Room 22	Miscellaneous	NAD
C-10	Drywall/joint compound	Room 22	Miscellaneous	NAD
C-11	Paper cover on fiberglass insulation	Room 5a	Miscellaneous	NAD
C-12	Paper cover on fiberglass insulation	Room 5a	Miscellaneous	NAD
C-13a	12” Floor tile – beige/grey	Room 5a	Miscellaneous	NAD
C-13b	Floor tile mastic – yellow	Room 5a	Miscellaneous	NAD
C-14a	12” Floor tile – beige/grey	Room 5a	Miscellaneous	NAD
C-14b	Floor tile mastic- yellow	Room 5a	Miscellaneous	NAD
C-15	Spray on ceiling – popcorn	Room 9	Surfacing	NAD



Table 6.3.2: Analytical Results Table				
Sample No	Material Description	Sample Location	Material Type	Results
	texture, white			
C-16	Spray on ceiling – popcorn texture, white	Hallway 4	Surfacing	NAD
C-17	Spray on ceiling – popcorn texture, white	Room 23	Surfacing	NAD
C-18	Spray on ceiling – popcorn texture, white	Hallway 4	Surfacing	NAD
C-19	Spray on ceiling – popcorn texture, white	Hallway 4	Surfacing	NAD
C-20	Spray on ceiling – popcorn texture, white	Hallway 3	Surfacing	NAD
C-21	Spray on ceiling – popcorn texture, white	Hallway 2	Surfacing	NAD
C-22	Spray on ceiling – popcorn texture, white	Hallway 2	Surfacing	NAD
C-23	2x4 Ceiling tile – white, dot pattern	Room 7a	Miscellaneous	NAD
C-24	2x4 Ceiling tile – white, dot pattern	Room 7a	Miscellaneous	NAD
C-25	2x2 Ceiling tile – white, worm hole pattern	Room 1 auditorium	Miscellaneous	NAD
C-26	2x2 Ceiling tile –white, worm hole pattern	Room 1 auditorium	Miscellaneous	NAD
C-27	Door caulking – brown	Front door	Miscellaneous	NAD
C-28	Door caulking – brown	Front door	Miscellaneous	NAD
C-29	Window caulking – grey/brown	Exterior window south side	Miscellaneous	NAD
C-30	Window caulking – grey/brown	Exterior window south side	Miscellaneous	NAD
Notes: NAD- No Asbestos Detected				

The Lead Based Painting screening for the Cooperative Extension Building included 15 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

**6.4 (D) LIVESTOCK ARENA**

A total of 8 bulk samples were collected from the Livestock Arena. The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

Table 6.4.1. Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
<b>MISCELLANEOUS</b>						
2x4 Ceiling Tile – white w/ decorative pattern	Room 2	D-1, D-2	All NAD	Good	N/A	N/A

<b>Table 6.4.1. Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
Carpet Mastic – yellow	Under green carpet in room 2	D-3, D-4	All NAD	Good	N/A	N/A
12" Floor tile – beige	Room 1	D-5a, D-6a	All NAD	Good	N/A	N/A
Floor tile mastic – yellow	Room 1 under floor tile	D-5b, D-6b	All NAD	Good	N/A	N/A
Roofing Material	Roof	Not Sampled	Assumed	Unknown	Category I non friable	Unknown
Vibration Dampers	On all HVAC system and connections throughout the building	Not Sampled	Assumed	Unknown	Category II non friable	Unknown
Notes: NAD – No Asbestos Detected    N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, type of homogenous category and laboratory results.

<b>Table 6.4.2: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
D-1	2x4 Ceiling tile – white with decorative pattern	Room 2	Miscellaneous	NAD
D-2	2x4 Ceiling tile – white with decorative pattern	Room 2	Miscellaneous	NAD
D-3	Carpet mastic – yellow	Room 2 under green carpet	Miscellaneous	NAD
D-4	Carpet mastic – yellow	Room 2 under green carpet	Miscellaneous	NAD
D-5a	12" Floor tile – beige	Room 1	Miscellaneous	NAD
D-5b	Floor tile mastic – yellow	Room 1 under floor tile	Miscellaneous	NAD
D-6a	12" Floor tile – beige	Room 1	Miscellaneous	NAD
D-6b	Floor tile mastic – yellow	Room 1 under floor tile	Miscellaneous	NAD
Notes: NAD – No Asbestos Detected    N/A – Non-Applicable				

Note: There is a building indicated on the floor plans labeled as Building #1. No access was granted to this building. Assume all materials to contain asbestos until further tested or proved otherwise.

The Lead Based Paint screening for the Livestock Building included 28 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

## **6.5 (E) ELECTIONS/ABC BUILDING**

A total of 54 bulk samples were collected from the Elections/ABC Building.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

<b>Table 6.5.2. Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Approx. Quantity</b>
<b>MISCELLANEOUS</b>						
Carpet Mastic-yellow, under grey and white carpet	Meeting Room 1 and Throughout other areas in BOE	E-1, E-2	All NAD	Good	N/A	N/A
Rubber Cove Base – black	Throughout BOE	E-3a, E-4a	All NAD	Good	N/A	N/A
Cove Base Mastic – yellow	Throughout BOE	E-3b, E-4b	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – grey, stucco pattern	Meeting Room 1 BOE	E-5, E-6	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – white, worm hole dot pattern	Room 12 Storage room BOE	E-7, E-8	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – worm hole pattern	Hallway 1 and Throughout BOE	E-9, E-10	All NAD	Good	N/A	N/A
Carpet Mastic – yellow	Hallway 1 BOE	E-11, E-12	All NAD	Good	N/A	N/A
12” Floor tile – tan	Hallway 1 BOE, under pink carpet	E-13a, E-14a	3 %C, PS	Good	Category I non friable	250 SF
Floor Tile Mastic – black	Hallway 1 BOE under floor tile	E-13b, E-14b	8 %C, PS	Good	Category II non friable	250 SF
Carpet Mastic-yellow	Room 3 BOE	E-15, E-16	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – white, dot pattern	All Rest rooms in BOE	E-17, E-18	All NAD	Good	N/A	N/A
Drywall/Joint compound	Throughout BOE, ABCBO, ABCS	E-19, E-20	All NAD	Good	N/A	N/A
Vinyl Flooring – white, block pattern	Room 9 Kitchen in BOE	E-21a, E-22a	All AND	Good	N/A	N/A
Vinyl Floor Mastic – yellow	Room 9 Kitchen in BOE, under vinyl flooring	E-21b, E-22b	All NAD	Good	N/A	N/A
Vinyl Flooring – unknown color and style	Under cabinets in room 9 Kitchen BOE	E-23, E-24	All NAD	Good	N/A	N/A
12” Floor Tile – grey multicolor	Bathroom hallway to ABC warehouse	E-25a, E-26a	All NAD	Good	N/A	N/A
Floor Tile Mastic – black	Under floor tile in the bathroom hallway to ABC warehouse	E-25b, E-26b	8 %C, PS	Good	Category II non friable	80 SF
Rubber Cove Base – blue	Bathroom hallway to ABC warehouse	E-27, E-28	All NAD	Good	N/A	N/A
Carpet Mastic – yellow	Throughout ABCS	E-29, E-30	All NAD	Good	N/A	N/A

Table 6.5.2. Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Approx. Quantity
Rubber Cove Base – grey	Throughout ABCS	E-31, E-32	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – white, worm hole and dot pattern	Throughout ABCS	E-33, E-34	All NAD	Good	N/A	N/A
Door Caulking – brown	All Exterior doors Throughout entire building	E-35, E-36	All NAD	Good	N/A	N/A
Carpet Mastic – yellow	Room 5 and Main lobby in ABCBO	E-37a, E-38a	All NAD	Good	N/A	N/A
Leveling Compound – grey	Room 5 and Main lobby in ABCBO	E-37b, E-38b	All NAD	Good	N/A	N/A
12” Floor tile – tan and brown	Throughout ABCBO	E-39b, E-40a	3 %C, PS	Good	Category I non friable	950 SF
Floor Tile Mastic – black	Throughout ABCBO under floor tile	E-39b, E-40a	8 %C, PS	Good	Category II non friable	950 SF
Joint Compound	Throughout ABCS	E-41, E-42	All NAD	Good	N/A	N/A
Vibration Dampers	On all HVAC system and connections throughout the building	Not Sampled	Assumed	Good	Category II non friable	Unknown
<p>Notes: C – Chrysotile fiber PS – Positive Stop Rule for Analyzing Samples NAD – No Asbestos Detected N/A – Not Applicable SF – Square Feet</p> <p>KCI reviewed documentation provided by the Lenoir County for the roofing material. The roofing material consists of Thermoplastic PVC Elvaloy system with silicone caulking. Based on this information KCI has excluded the roofing material as a suspect ACBM, however, KCI recommends testing the roofing material prior to any disturbance, renovation or demolition of the roof.</p>				<p><u>Sample Location Key</u> BOE = Board of Elections ABCBO = ABC Board Offices ABCS = ABC Store</p>		

The analytical results table describes the suspect material sampled, location of sampling, type of homogenous category and laboratory results.

Table 6.5.1: Analytical Results Table				
Sample No	Material Description	Sample Location	Material Type	Results
E-1	Carpet mastic – yellow	Meeting room 1 BOE	Miscellaneous	NAD
E-2	Carpet mastic – yellow	Meeting room 1 BOE	Miscellaneous	NAD
E-3a	Rubber covebase – black	Meeting room 1 BOE	Miscellaneous	NAD
E-3b	Cove base mastic – yellow	Meeting room 1 BOE	Miscellaneous	NAD
E-4a	Rubber covebase – black	Meeting room 1 BOE	Miscellaneous	NAD
E-4b	Cove base mastic – yellow	Meeting room 1 BOE	Miscellaneous	NAD
E-5	2x2 Ceiling tile – grey, stucco pattern	Meeting room 1 BOE	Miscellaneous	NAD
E-6	2x2 Ceiling tile – grey, stucco	Meeting room 1 BOE	Miscellaneous	NAD

**Table 6.5.1: Analytical Results Table**

Sample No	Material Description	Sample Location	Material Type	Results
	pattern			
E-7	2x2 Ceiling tile – white, worm hole dot pattern	Room 12 storage BOE	Miscellaneous	NAD
E-8	2x2 Ceiling tile – white, worm hole dot pattern	Room 12 storage BOE	Miscellaneous	NAD
E-9	2x2 Ceiling tile – white, worm hole pattern	Hallway 1 BOE	Miscellaneous	NAD
E-10	2x2 Ceiling tile – white, worm hole pattern	Hallway 1 BOE	Miscellaneous	NAD
E-11	Carpet mastic – yellow, under pink carpet	Hallway 1 BOE	Miscellaneous	NAD
E-12	Carpet mastic – yellow, under pink carpet	Hallway 1 BOE	Miscellaneous	NAD
E-13a	12” Floor tile – tan, under pink carpet	Hallway 1 BOE	Miscellaneous	3 % Chrysotile
E-13b	Floor tile mastic – under floor tile, black	Hallway 1 BOE	Miscellaneous	8 % Chrysotile
E-14a	12” Floor tile – tan, under pink carpet	Hallway 1 BOE	Miscellaneous	3 % Chrysotile
E-14b	Floor tile mastic – under floor tile, black	Hallway 1 BOE	Miscellaneous	8 % Chrysotile
E-15	Carpet mastic – yellow, under blue carpet squares	Room 3 BOE	Miscellaneous	NAD
E-16	Carpet mastic – yellow, under blue carpet squares	Room 3 BOE	Miscellaneous	NAD
E-17	2x2 Ceiling tile –white, dot pattern	Room 10	Miscellaneous	NAD
E-18	2x2 Ceiling tile – white, dot pattern	Room 10	Miscellaneous	NAD
E-19	Drywall/joint compound	Meeting room 1 BOE	Miscellaneous	NAD
E-20	Drywall/joint compound	Room 9 kitchen BOE	Miscellaneous	NAD
E-21a	Vinyl flooring – white, block pattern	Room 9 kitchen BOE	Miscellaneous	NAD
E-21b	Vinyl floor mastic – yellow, under vinyl flooring	Room 9 kitchen BOE	Miscellaneous	NAD
E-22a	Vinyl flooring – white, box pattern	Room 9 kitchen BOE	Miscellaneous	NAD
E-22b	Vinyl floor mastic – yellow, under vinyl flooring	Room 9 kitchen BOE	Miscellaneous	NAD
E-23	Vinyl flooring – under cabinets	Room 9 kitchen BOE	Miscellaneous	NAD
E-24	Vinyl flooring – under cabinets	Room 9 kitchen BOE	Miscellaneous	NAD
E-25a	12” Floor tile – grey multicolor	Bathroom hallway to ABCS warehouse	Miscellaneous	NAD
E-25b	Floor tile mastic – black, under floor tile	Bathroom hallway to ABCS warehouse	Miscellaneous	8 % Chrysotile
E-26a	12” Floor tile – grey multicolor	Bathroom hallway to ABCS warehouse	Miscellaneous	NAD
E-26b	Floor tile mastic – black, under floor tile	Bathroom hallway to ABCS warehouse	Miscellaneous	8 % Chrysotile
E-27	Rubber covebase – blue	Bathroom hallway to ABCS warehouse	Miscellaneous	NAD

Table 6.5.1: Analytical Results Table				
Sample No	Material Description	Sample Location	Material Type	Results
E-28	Rubber covebase – blue	Bathroom hallway to ABCS warehouse	Miscellaneous	NAD
E-29	Carpet mastic – yellow, under multi-color carpet	Office in ABCS	Miscellaneous	NAD
E-30	Carpet mastic – yellow, under multi-color carpet	Office in ABCS	Miscellaneous	NAD
E-31	Rubber covebase – grey	Office in ABCS	Miscellaneous	NAD
E-32	Rubber covebase – grey	Office in ABCS	Miscellaneous	NAD
E-33	2x2 Ceiling tile – white, worm hole and dot pattern	ABCS, next to checkout	Miscellaneous	NAD
E-34	2x2 Ceiling tile – white, worm hole and dot patter	ABCS, next to nc brands display	Miscellaneous	NAD
E-35	Door caulking – brown	Front door ABCS	Miscellaneous	NAD
E-36	Door caulking – brown	Front door ABCS	Miscellaneous	NAD
E-37a	Carpet mastic – yellow	Room 5 ABCS	Miscellaneous	NAD
E-37b	Leveling compound – grey	Room 5 ABCS	Miscellaneous	NAD
E-38a	Carpet mastic – yellow	Room 5 ABCS	Miscellaneous	NAD
E-38b	Leveling compound – grey	Room 5 ABCS	Miscellaneous	NAD
E-39a	12” Floor tile – tan and brown	Hallway 2 ABCS	Miscellaneous	3 % Chrysotile
E-39b	Floor tile mastic – black	Hallway 2 ABCS	Miscellaneous	8 % Chrysotile
E-40a	12” Floor tile – tan and brown	Hallway 2 ABCS	Miscellaneous	3 % Chrysotile
E-40b	Floor tile mastic – black	Hallway 2 ABCS	Miscellaneous	8 % Chrysotile
E-41	Joint compound	ABCS, next to vodka display	Miscellaneous	NAD
E-42	Joint compound	ABCS, next to rum display	Miscellaneous	NAD
Note: C- Chrysotile fiber PS – Positive Stop Rule for Analyzing Samples NAD – No Asbestos Detected			Sample Location Key BOE = Board of Elections ABCBO = ABC Board Offices ABCS = ABC Store	

The Lead Based Paint screening for the Elections/ABC Buildings included 33 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

**6.6 (F) HEALTH DEPARTMENT**

A total of 32 bulk samples were collected from Health Department. The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

Table 6.6.1: Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
<b>SURFACING</b>						
Plaster – base	Throughout the building	F-20, F-22, F-24 F-26, F-28	All NAD	Good	N/A	N/A

Table 6.6.1: Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
Plaster – skim	Throughout the building	F-19, F-21, F-23 F-25, F-27	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
Carpet Mastic – yellow	Throughout the building	F-13, F-14	All NAD	Good	N/A	N/A
2x4 Ceiling Tile	Throughout the building	F-29, F-30	All NAD	Good	N/A	N/A
Covebase – brown	Throughout the building	F-1, F-2	All NAD	Good	N/A	N/A
Drywall/ Joint Compound	Throughout the building	F-17, F-18 , F-31 F-32	All NAD	Good	N/A	N/A
12” Floor Tile – tan w/ brown streaks	Corridor C4, Patient Area 1, 2, 3, Stairs	F-9, F-10	3%C, PS	Good	Category I non friable	1,700 SF
12” Floor Tile – white w/ brown streaks	Throughout the building	F-5, F-6	All NAD	Good	N/A	N/A
Mastic – brown & black	Throughout the building	F-7, F-8, F-11 F-12	All NAD	Good	N/A	N/A
Mastic – yellow	Throughout the building	F-3, F-4	All NAD	Good	N/A	N/A
Fire Door	Throughout the building	Not Sampled	Assumed	Good	Category II non friable	2 Each
Roofing material	Roof	Not Sampled	Assumed	Good	Category I non friable	12,800 SF
Notes: C – Chrysotile Fiber    NAD – No Asbestos Detected    SF – Square Feet    PS – Positive Stop N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, type of homogenous category and laboratory results.

Table 6.6.2: Analytical Results Table				
Sample No	Material Description	Sample Location	Material Type	Results
F-1	Covebase – brown	1st floor – break room	Miscellaneous	NAD
F-2	Covebase – brown	1st floor – break room	Miscellaneous	NAD
F-3	Mastic – yellow	Behind F-1	Miscellaneous	NAD
F-4	Mastic – yellow	Behind F-2	Miscellaneous	NAD
F-5	12” floor tile – white w/ brown streaks	Corridor by room 80	Miscellaneous	NAD
F-6	12” floor tile – white w/ brown streaks	Corridor by room 80	Miscellaneous	NAD
F-7	Mastic – brown/black	Beneath F-5	Miscellaneous	NAD
F-8	Mastic – brown/black	Beneath F-6	Miscellaneous	NAD
F-9	12” floor tile – tan w/ brown streaks	North 1 <sup>st</sup> floor- Closet by Lav 3	Miscellaneous	3% Chrysotile

Sample No	Material Description	Sample Location	Material Type	Results
F-10	12" floor tile – tan w/ brown streaks	North 1 <sup>st</sup> floor- Closet by Lav 3	Miscellaneous	Positive Stop
F-11	Mastic – brown/black	Beneath F-9	Miscellaneous	NAD
F-12	Mastic – brown/black	Beneath F-10	Miscellaneous	NAD
F-13	Carpet mastic – yellow	Room 21	Miscellaneous	NAD
F-14	Carpet mastic – yellow	Room 22	Miscellaneous	NAD
F-15	2x4 Ceiling tile	Corridor C4	Miscellaneous	NAD
F-16	2x4 Ceiling tile	1st floor stairs	Miscellaneous	NAD
F-17	Drywall/ joint compound	1st floor stair landing (wall)	Miscellaneous	NAD
F-18	Drywall/ joint compound	1st floor closet near stairs	Miscellaneous	NAD
F-19	Plaster – skim	1st floor north wing corridor	Surfacing	NAD
F-20	Plaster – base	1st floor north wing corridor	Surfacing	NAD
F-21	Plaster – skim	1st floor north wing corridor	Surfacing	NAD
F-22	Plaster – base	1st floor north wing corridor	Surfacing	NAD
F-23	Plaster – skim	1st floor north wing corridor	Surfacing	NAD
F-24	Plaster – base	1st floor north wing corridor	Surfacing	NAD
F-25	Plaster – skim	1st floor north wing corridor	Surfacing	NAD
F-26	Plaster – base	1st floor north wing corridor	Surfacing	NAD
F-27	Plaster – skim	1st floor north wing corridor	Surfacing	NAD
F-28	Plaster – base	1st floor north wing corridor	Surfacing	NAD
F-29	2x4 ceiling tile	1st floor south wing corridor	Miscellaneous	NAD
F-30	2x4 ceiling tile	1st floor south wing corridor	Miscellaneous	NAD
F-31	Drywall/joint compound	South wing 1st floor – janitor closet	Miscellaneous	NAD
F-32	Drywall/joint compound	South wing 1st floor – janitor closet	Miscellaneous	NAD
Notes: NAD – No Asbestos Detected    Positive Stop – Rule for Analyzing Samples				

The Lead Based Paint screening for the Health Department Building included 40 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

**6.7 (G) SOCIAL SERVICES**

A total of 36 bulk samples were collected from Social Services.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
<b>SURFACING</b>						
Plaster – base	Throughout the building	G-4, G-6, G-8, G-16, G-18	All NAD	Good	N/A	N/A



<b>Table 6.7.1: Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
Plaster – skim	Throughout the building	G-3, G-5, G-7, G-15, G-17	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
1x1 Ceiling Tile – spline	Throughout the building	G-9, G-10	All NAD	Good	N/A	N/A
2x4 Ceiling Tile – tan	Throughout the building	G-31, G-32	All NAD	Good	N/A	N/A
2x4 Ceiling Tile – white	Throughout the building	G-29, G-30	All NAD	Good	N/A	N/A
Covebase – grey	Throughout the building	G-35, G-36	All NAD	Good	N/A	N/A
Covebase Mastic – yellow	Throughout the building	G-23, G-24	All NAD	Good	N/A	N/A
Drywall/ Joint Compound	Throughout the building	G-1, G-2	All NAD	Good	N/A	N/A
9” Floor Tile – beige and associated mastic	2 <sup>nd</sup> Floor Room 3 and landing of stairway to 2 <sup>nd</sup> floor	Not Sampled	Assumed	Good	Category I non friable	40 SF
12” Floor Tile – green	Throughout the building	G-25 G-27	All NAD	Good	N/A	N/A
Linoleum Flooring – yellow	Throughout the building	G-11, G-12	All NAD	Good	N/A	N/A
Mastic – black	Beneath 12” green floor tiles throughout the building	G-26, G-28	6% C, PS	Good	Category I non friable	2,250 SF
Mastic – yellow	Throughout the building below linoleum	G-13, G-14	All NAD	Good	N/A	N/A
Mastic – brown	On stairs to 2 <sup>nd</sup> floor Storage Area	G-19, G-20	All NAD	Good	N/A	N/A
Carpet Mastic – beige	Throughout the building	G-21, G-22	All NAD	Good	N/A	N/A
Window Caulk – brown	Exterior of Building	G-33, G-34	All NAD	Good	N/A	N/A
Fire Doors	West Exit Door	Not Sampled	Assumed	Good	Category II non friable	1 EA
Vibration Dampers	On all HVAC system and connections throughout the building	Not Sampled	Assumed	Unknown	Category II non friable	Unknown
<p>Notes:                      C – Chrysotile Fiber    NAD – No Asbestos Detected    SF – Square Feet    EA – Each    PS – Positive Stop                      N/A – Non-Applicable</p> <p>KCI reviewed documentation provided by the Lenoir County for the roofing material. The roofing material consists of Thermoplastic PVC Elvaloy system with silicone caulking. Based on this information KCI has excluded the roofing material as a suspect ACBM, however, KCI recommends testing the roofing material prior to any disturbance, renovation or demolition of the roof.</p>						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
G-1	Drywall/joint compound	2nd floor – storage room	Miscellaneous	NAD
G-2	Drywall/joint compound	2nd floor – storage room	Miscellaneous	NAD
G-3	Plaster – skim	2nd floor – storage room	Surfacing	NAD
G-4	Plaster – base	2nd floor – storage room	Surfacing	NAD
G-5	Plaster – skim	2nd floor – storage room	Surfacing	NAD
G-6	Plaster – base	2nd floor – storage room	Surfacing	NAD
G-7	Plaster – skim	2nd floor – storage room	Surfacing	NAD
G-8	Plaster – base	2nd floor – storage room	Surfacing	NAD
G-9	1x1 ceiling tile – spine	Stairs to 2nd floor storage	Miscellaneous	NAD
G-10	1x1 ceiling tile – spine	Stairs to 2nd floor storage	Miscellaneous	NAD
G-11	Linoleum flooring – yellow	2nd floor storage hallway	Miscellaneous	NAD
G-12	Linoleum flooring – yellow	2nd floor storage room 1	Miscellaneous	NAD
G-13	Mastic – yellow	Beneath G-11	Miscellaneous	NAD
G-14	Mastic – yellow	Beneath G-12	Miscellaneous	NAD
G-15	Plaster – skim	2nd floor storage room 2	Surfacing	NAD
G-16	Plaster – base	2nd floor storage room 2	Surfacing	NAD
G-17	Plaster – skim	2nd floor storage room 3	Surfacing	NAD
G-18	Plaster – base	2nd floor storage room 3	Surfacing	NAD
G-19	Mastic – brown	Stairs to 2nd floor storage	Miscellaneous	NAD
G-20	Mastic – brown	Stairs to 2nd floor storage	Miscellaneous	NAD
G-21	Carpet mastic – beige	1st floor – entrance to stairs for storage on 2nd floor	Miscellaneous	NAD
G-22	Carpet mastic – beige	1st floor – office by stairs to 2nd floor	Miscellaneous	NAD
G-23	Covebase mastic – yellow	1st floor – entrance to stairs for 2nd floor	Miscellaneous	NAD
G-24	Covebase mastic – yellow	1st floor – entrance to stairs for 2nd floor	Miscellaneous	NAD
G-25	12" Floor tile – green	1st floor – valve room next to office 6352	Miscellaneous	NAD
G-26	Mastic – black	1st floor – valve room next to office 6352	Miscellaneous	6% Chrysotile
G-27	12" Floor tile – green	1st floor – boiler room (next to break room)	Miscellaneous	NAD
G-28	Mastic – black	1st floor – boiler room (next to break room)	Miscellaneous	Positive Stop
G-29	2x4 Ceiling tiles – white	1st floor – boiler room (next to break room)	Miscellaneous	NAD
G-30	2x4 Ceiling tiles – white	1st floor corridor by break room	Miscellaneous	NAD
G-31	2x4 Ceiling tiles – tan	1st floor break room corridor	Miscellaneous	NAD
G-32	2x4 Ceiling tiles – tan	1st floor break room	Miscellaneous	NAD
G-33	Window caulk – brown	Exterior – north side of building	Miscellaneous	NAD
G-34	Window caulk – brown	Exterior – east side of	Miscellaneous	NAD

Table 6.7.1: Analytical Results Table				
Sample No	Material Description	Sample Location	Material Type	Results
		building rear entrance		
G-35	Covebase – grey	1st floor entrance to stairs	Miscellaneous	NAD
G-36	Covebase – grey	1st floor entrance to stairs	Miscellaneous	NAD
Notes: NAD – No Asbestos Detected    Positive Stop – Rule for Analyzing Samples				

The Lead Based Paint screening for the Social Services Building included 18 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

**6.8 (H) RESOURCE DEVELOPMENT BUILDING**

A total of 65 bulk samples were collected from the Resource Development Building. The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

Table 6.8.2. Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
<b>THERMAL SYSTEM INSULATION</b>						
Pipe Insulation and associated debris –Aircell, white	All boiler lines in crawlspace & basement including inaccessible wall chassis throughout the building	H-31, H-32, H-37, H-38	60% C, PS, 10% C , PS	Damaged	Friable	350 LF
Pipe Fitting Insulation and associated debris – white	2” Boiler line in basement & crawlspace and in inaccessible wall chassis throughout the building	H-33, H-34, H-48	15 %C, PS, PS	Damaged	Friable	50 EA
Boiler Insulation (exterior)	Main boiler in basement	Not Sampled	Assumed	Damaged	Friable	120 SF
<b>SURFACING</b>						
Plaster – skim	Throughout front half of building	H-41a, H-42a, H-43a, H-44a, H-45a, H-46a, H-47a	All NAD	Good	N/A	N/A
Plaster – base	Throughout front half of building	H-41b, H-42b, H-43b, H-44b, H-45b, H-46b, H-47b	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
Carpet Mastic – black	Throughout the building	H-17, H-18, H-21, H-22	All NAD	Good	N/A	N/A

<b>Table 6.8.2. Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
1x1 Wall Tiles – white , worm hole pattern	Throughout back half of building	H-1, H-2	All NAD	Good	N/A	N/A
1x1 Ceiling Tile – white	Through back half of building	H-3, H-4	All NAD	Good	N/A	N/A
2x4 Ceiling Tile –dot pattern	Throughout front section of building	H-29, H-30	All NAD	Good	N/A	N/A
2x4 Ceiling Tile – white, worm hole	Throughout the building	H-5, H-6	All NAD	Good	N/A	N/A
Door Caulking	All Exterior doors	H-11, H-12	NAD, 3%C	Good	Category II non friable	60 LF
Drywall	Throughout the building	H-15, H-16 H-27a, H-28a H-39a, H-40a	All NAD	Good	N/A	N/A
Drywall/Joint compound	Throughout the building	H-27, H-28 H-39, H-40	All NAD	Good	N/A	N/A
Joint compound	Throughout the building	H-27b, H-28b H-39b, H-40b	3%C, 3%C, NAD, NAD	Good	Friable	Applied over 6,000 SF of drywall
Paper Wrap – brown	On HVAC duct work and around units in Basement and Crawlspace	H-35, H-36	All NAD	Good	N/A	N/A
12” Vinyl Flooring – brown marble	Bathroom 1 and 2	H-13a, H-14a	All NAD	Good	N/A	N/A
Vinyl Floor Mastic Top Layer – yellow	Bathroom 1 and 2	H-13b, H-14b	All NAD	Good	N/A	N/A
Vinyl Flooring – bottom layer, white	Bathroom 1 and 2	H-13c	All NAD	Good	N/A	N/A
Vinyl Floor mastic – bottom layer, yellow	Bathroom 1 and 2	H-13d	All NAD	Good	N/A	N/A
Vinyl flooring – tan	Room 14A	H-19a, H-20a	All NAD	Good	N/A	N/A
Vinyl Flooring Mastic – brown	Room 14A	H-19b, H-20b	All NAD	Good	N/A	N/A
Felt Underlayment – black	Room 14A under vinyl	H-19c, H-20c	All NAD	Good	N/A	N/A
Vinyl Flooring – cream and tan	Under carpet in Room 21	H-25a, H-26a	All NAD	Good	N/A	N/A
Vinyl Floor Mastic	Under vinyl in room 21	H-25b, H-26b	All NAD	Good	N/A	N/A

<b>Table 6.8.2. Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
Window Glazing – tan painted white	All window front half of building	H-23, H-24	All NAD	Good	N/A	N/A
Window Glazing – white	On all metal windows, back half of building	H-7, H-8	All NAD	Good	N/A	N/A
Window Glazing – white	Small metal windows in Bathroom 1 and 2	H-9, H-10	All NAD	Good	N/A	N/A
Asphalt Roof Shingles – black	Roof	Not Sampled	Assumed	Good	Category I non friable	6,000 SF
Exterior window caulking – white and tan	All Exterior windows	Not Sampled	Assumed	Good	Category II non friable	400 LF
9” Floor tile – dark color	Throughout back section of building, Rooms 1-11 and hallways	Not Sampled	Assumed	Good	Category I	1,250 SF
Floor tile mastic – black	Beneath floor tile in back section of building, rooms 1-11 and hallways	Not Sampled	Assumed	Good	Category II non friable	1,250 SF
Interior Boiler Materials (refractory brick & mortar, packings, gaskets, caulking, etc.)	Interior of boiler in basement	Not Sampled	Assumed	Unknown	Category I non friable	Unknown
Gasket on exterior of Boiler	On main boiler in basement	Not Sampled	Assumed	Good	Category I non friable	25 SF
Notes: C – Chrysotile Fiber    NAD – No Asbestos Detected    SF – Square Feet    LF – Linear Feet    EA – Each PS – Positive Stop    N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

<b>Table 6.8.1: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
H-1	12” Wall tiles – white worm hole pattern	Room 4	Miscellaneous	NAD
H-2	12” Wall tiles – white worm hole pattern	Room 4	Miscellaneous	NAD
H-3	1x1 Ceiling tile – white	Hallway 1 outside room 2	Miscellaneous	NAD
H-4	1x1 Ceiling tile – white	Hallway 2 outside room 9	Miscellaneous	NAD
H-5	2x4 Ceiling tile – white, worm hole	Hallway 1 outside room 8	Miscellaneous	NAD
H-6	2x4 Ceiling tile – white, worm hole	Hallway 1 outside room 5	Miscellaneous	NAD
H-7	Window glazing – white on	Room 7	Miscellaneous	NAD

**Table 6.8.1: Analytical Results Table**

Sample No	Material Description	Sample Location	Material Type	Results
	metal window			
H-8	Window glazing – white on metal window	Room 5	Miscellaneous	NAD
H-9	Window glazing – white on metal window	Bathroom 1	Miscellaneous	NAD
H-10	Window glazing – white on metal window	Bathroom 2	Miscellaneous	NAD
H-11	Door caulking – white	East side door on back half of building	Miscellaneous	NAD
H-12	Door caulking – white	West side door on back half of building	Miscellaneous	3 % Chrysotile
H-13a	12” Vinyl flooring – brown marble	Bathroom 1	Miscellaneous	NAD
H-13b	Vinyl mastic – yellow	Bathroom 1	Miscellaneous	NAD
H-13c	Vinyl flooring bottom layer – white	Bathroom 1	Miscellaneous	NAD
H-13d	Vinyl mastic – yellow	Bathroom 1	Miscellaneous	NAD
H-14a	12” Vinyl flooring – brown marble	Bathroom 2	Miscellaneous	NAD
H-14b	Vinyl mastic – yellow	Bathroom 2	Miscellaneous	NAD
H-15	Drywall – yellow	Room 9a	Miscellaneous	NAD
H-16	Drywall – yellow	Room 9a	Miscellaneous	NAD
H-17	Carpet mastic	Room 9a	Miscellaneous	NAD
H-18	Carpet mastic	Room 9a	Miscellaneous	NAD
H-19a	Vinyl flooring – tan	Room 14a	Miscellaneous	NAD
H-19b	Vinyl floor mastic – brown	Room 14a	Miscellaneous	NAD
H-19c	Felt underlayment – black	Under vinyl in room 14a	Miscellaneous	NAD
H-20a	Vinyl flooring – tan	Room 14a	Miscellaneous	NAD
H-20b	Vinyl floor mastic – brown	Room 14a	Miscellaneous	NAD
H-20c	Felt underlayment – black	Under vinyl in room 14 a	Miscellaneous	NAD
H-21	Carpet mastic – black	Room 18	Miscellaneous	NAD
H-22	Carpet mastic – black	Room 18	Miscellaneous	NAD
H-23	Window glazing – hard, tan painted white	Room 21	Miscellaneous	NAD
H-24	Window glazing – hard, tan painted white	Room 19	Miscellaneous	NAD
H-25a	Vinyl flooring – cream and tan, under carpet	Room 21	Miscellaneous	NAD
H-25b	Vinyl floor mastic – yellow	Room 21	Miscellaneous	NAD
H-26a	Vinyl flooring – cream and tan, under carpet	Room 21	Miscellaneous	NAD
H-26b	Vinyl floor mastic – yellow	Room 21	Miscellaneous	NAD
H-27	Drywall/joint compound	Hallway 2 outside room 22	Miscellaneous	NAD
H-27a	Drywall	Hallway 2 outside room 22	Miscellaneous	NAD
H-27b	Joint compound	Hallway 2 outside room 22	Miscellaneous	3 % Chrysotile
H-28	Drywall/Joint compound	Hallway 2 outside room 17	Miscellaneous	NAD
H-28a	Drywall	Hallway 2 outside room 17	Miscellaneous	NAD
H-28b	Joint compound	Hallway 2 outside room 17	Miscellaneous	3 % Chrysotile

**Table 6.8.1: Analytical Results Table**

Sample No	Material Description	Sample Location	Material Type	Results
H-29	2x4 Ceiling tile – dot pattern, white	Hallway 2 outside room 14 a	Miscellaneous	NAD
H-30	2x4 Ceiling tile – dot pattern, white	Hallway 2 outside room 16	Miscellaneous	NAD
H-31	Pipe insulation – aircell white	At rear of boiler # 6 in basement	TSI	60% Chrysotile
H-32	Pipe insulation – aircell white	At rear of boiler # 6 in basement	TSI	Positive Stop
H-33	Pipe Fitting insulation – white	Elbows on 2” boiler line in basement and crawlspace	TSI	15% Chrysotile
H-34	Pipe Fitting insulation – white	Elbows on 2” boiler line in basement and crawlspace	TSI	Positive Stop
H-35	Paper wrap – brown	Unit 3 HVAC unit in basement	Miscellaneous	NAD
H-36	Paper wrap – brown	Unit 3 HVAC unit in basement	Miscellaneous	NAD
H-37	Pipe insulation – aircell, white	2” line in crawlspace and basement	TSI	10% Chrysotile
H-38	Pipe insulation – aircell, white	2” line in crawlspace and basement	TSI	10% Chrysotile
H-39	Drywall /joint compound	Basement wall at entrance	Miscellaneous	NAD
H-39a	Drywall	Basement wall at entrance	Miscellaneous	NAD
H-39b	Joint compound	Basement wall at entrance	Miscellaneous	NAD
H-40	Drywall/joint compound	Basement wall at east side	Miscellaneous	NAD
H-40a	Drywall	Basement wall at east side	Miscellaneous	NAD
H-40b	Joint compound	Basement wall at east side	Miscellaneous	NAD
H-41a	Plaster – skim	Room 15	Surfacing	NAD
H-4b	Plaster – base	Room 15	Surfacing	NAD
H-42a	Plaster – skim	Room 14	Surfacing	NAD
H-42b	Plaster – base	Room 14	Surfacing	NAD
H-43a	Plaster – skim	Room 22	Surfacing	NAD
H-43b	Plaster – base	Room 22	Surfacing	NAD
H-44a	Plaster – skim	Room 17	Surfacing	NAD
H-44b	Plaster – base	Room 17	Surfacing	NAD
H-45a	Plaster – skim	Room 20	Surfacing	NAD
H-45b	Plaster – base	Room 20	Surfacing	NAD
H-46a	Plaster – skim	Room 21	Surfacing	NAD
H-46b	Plaster – base	Room 21	Surfacing	NAD
H-47a	Plaster – skim	Room 19	Surfacing	NAD
H-47b	Plaster – base	Room 19	Surfacing	NAD
H-48	Pipe Fitting Insulation – white	Elbow on 2” boiler line in crawlspace and basement	TSI	Positive Stop
Notes: NAD – No Asbestos Detected    TSI – Thermal System Insulation    Positive Stop – Rule for Analyzing Samples				

The Lead Based Paint screening for the Resource Development building included 22 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

**6.9 (I) NATURE CENTER AND EDUCATION BUILDING**

A total of 23 bulk samples were collected from the Nature Center and Education Building. Building 1 is referred to as the Nature Center (samples I-01 thru I-11) and Building 2 is referred to as the Education Building (samples I-12 thru I-19).

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

<b>Table 6.9.2. Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
<b>SURFACING</b>						
Stucco Finish Material – grey	Throughout Basement Cave Exhibit of the Nature Center	I-7, I-8, I-9, I-10, I-11	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
Drywall/Joint Compound	Throughout the Nature center building	I-1, I-2	All NAD	Good	N/A	N/A
Drywall	Throughout the Nature center building	I-1a, I-2a	All NAD	Good	N/A	N/A
Joint Compound	Throughout the Nature center building	I-1b, I-2b	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – grey worm & dot	Throughout the Nature Center	I-3, I-4	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – white worm & dot	Throughout the Nature Center	I-5, I-6	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – white stucco	Throughout Main room of the Education building	I-12, I-13	All NAD	Good	N/A	N/A
2x4 Ceiling Tile – white worm hole	Throughout bathroom and hallway of education building	I-14, I-15	All NAD	Good	N/A	N/A
2x4 Ceiling Tile – white, worm & dot	Throughout bathroom and hallway of education building	I-16, I-17	All NAD	Good	N/A	N/A
Drywall/Joint Compound	Throughout the Education Building	I-18, I-19	All NAD	Good	N/A	N/A
Drywall	Throughout the Education building	I-18a, I-19a	All NAD	Good	N/A	N/A
Joint Compound	Throughout the Education building	I-18b, I-19b	All NAD	Good	N/A	N/A
Built up roofing and associated mastic	Throughout entire roof on Nature center	Not Sampled	Assumed	Good	Category I non friable	3,750 SF
Roof paint on metal seamed roof	Throughout entire roof on education center	Not Sampled	Assumed	Good	Category I non friable	2,500 SF



Table 6.9.2. Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
Vibration dampers	On HVAC system throughout the Nature center and Education Building	Not Sampled	Assumed	Good	Category II non friable	Unknown
Notes: NAD – No Asbestos Detected SF – Square Feet N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

Table 6.9.1: Analytical Results Table				
Sample No	Material Description	Sample Location	Material Type	Results
I-1	Drywall/joint compound	Rear wall of nature center	Miscellaneous	NAD
I-1a	Drywall	Rear wall of nature center	Miscellaneous	NAD
I-1b	Joint compound	Rear wall of nature center	Miscellaneous	NAD
I-2	Drywall/joint compound	Front wall of nature center	Miscellaneous	NAD
I-2a	Drywall	Front wall of nature center	Miscellaneous	NAD
I-2b	Joint compound	Front wall of nature center	Miscellaneous	NAD
I-3	2x2 Ceiling tile – grey worm & dot	Main room of nature center	Miscellaneous	NAD
I-4	2x2 Ceiling tile – grey worm & dot	Main room of nature center	Miscellaneous	NAD
I-5	2x2 Ceiling tile – white worm & dot	Main room of nature center	Miscellaneous	NAD
I-6	2x2 Ceiling tile – white worm & dot	Main room of nature center	Miscellaneous	NAD
I-7	Stucco finish material – grey	Basement, cave exhibit area of nature center	Surfacing	NAD
I-8	Stucco finish material – grey	Basement, cave exhibit area of nature center	Surfacing	NAD
I-9	Stucco finish material – grey	Basement, cave exhibit area of nature center	Surfacing	NAD
I-10	Stucco finish material – grey	Basement, cave exhibit area of nature center	Surfacing	NAD
I-11	Stucco finish material – grey	Basement, cave exhibit area of nature center	Surfacing	NAD
I-12	2x2 Ceiling tile – white stucco	Throughout main room of education building	Miscellaneous	NAD
I-13	2x2 Ceiling tile – white stucco	Throughout main room of education building	Miscellaneous	NAD
I-14	2x4 Ceiling tile – white worm	Bath room of education building	Miscellaneous	NAD
I-15	2x4 Ceiling tile – white worm	Bath room of education building	Miscellaneous	NAD
I-16	2x4 Ceiling tile – white worm & dot	Rear hallway of education building	Miscellaneous	NAD
I-17	2x4 Ceiling tile – white worm &	Rear hallway of education	Miscellaneous	NAD

Table 6.9.1: Analytical Results Table				
Sample No	Material Description	Sample Location	Material Type	Results
	dot	building		
I-18	Drywall/joint compound	Rear wall main room of education building	Miscellaneous	NAD
I-18a	Drywall	Rear wall main room of education building	Miscellaneous	NAD
I-18b	Joint compound	Rear wall main room of education building	Miscellaneous	NAD
I-19	Drywall/joint compound	Front wall main room of education building	Miscellaneous	NAD
I-19a	Drywall	Front wall main room of education building	Miscellaneous	NAD
I-19b	Joint compound	Front wall main room of education building	Miscellaneous	NAD
Notes: NAD – No Asbestos Detected				

The Lead Based Paint screening for the Nature Center and Education Building included 19 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

**6.10 (J) PLANETARIUM**

A total of 37 bulk samples were collected from the Planetarium.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

Table 6.10.1. Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
<b>THERMAL SYSTEM INSULATION</b>						
Debris – white mixed w/ dirt	Basement floor	J-20, J-21	All NAD	Damaged	N/A	N/A
Transite	Around basement Windows	J-22, J-23	All NAD	Good	N/A	N/A
<b>SURFACING</b>						
Plaster – base	Throughout the building	J-18a J-19a J-31	All NAD	Good	N/A	N/A
Plaster – skim	Throughout the building	J-18b, J-19b J-30	All NAD	Good	N/A	N/A
Spray on Ceiling popcorn – white w/ black specs	Throughout 1 <sup>st</sup> floor	J-7, J-8, J-9 J-10, J-11	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
2x2 Ceiling Tile – grey worm & dot	Throughout the building	J-1, J-2	All NAD	Good	N/A	N/A

<b>Table 6.10.1. Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
2x2 Ceiling Tile – grey stucco	Throughout the building	J-3, J-4	All NAD	Good	N/A	N/A
Drywall/Joint Compound	Throughout the building	J-12, J-13	All NAD	Good	N/A	N/A
Drywall	Throughout the building	J-12a, J-12a	All NAD	Good	N/A	N/A
Exterior door Caulking – white	Around all Exterior doors	J-24, J-25	All NAD	Good	N/A	N/A
Exterior Window Caulking	Around All original exterior windows	J-26, J-27	All NAD	Good	N/A	N/A
12” Floor tile – orange	Throughout the building	J-5a, J-6a	All NAD	Good	N/A	N/A
Floor Tile Mastic – yellow	Throughout the building	J-5b, J-6b	All NAD	Good	N/A	N/A
Joint Compound	Throughout the building	J-12b, J-12b	All NAD	Good	N/A	N/A
Planetarium Screen – white	2 <sup>nd</sup> Floor planetarium Ceiling	J-16, J-17	All NAD	Good	N/A	N/A
Stair case Tread	On all interior staircases	J-28, J-29	All NAD	Good	N/A	N/A
Vinyl Covebase – black	Throughout the building	J-14a, J-15a	All NAD	Good	N/A	N/A
Vinyl Covebase Mastic – clear	Throughout the building	J-14b, J-15b	All NAD	Good	N/A	N/A
Built up roofing material and all associated mastics	Roof	Not Sampled	Assumed	Good	Category I non friable	2,150 SF
Vibration Dampers	All HVAC units throughout the building	Not Sampled	Assumed	Good	Category II non friable	Unknown
Notes: NAD – No Asbestos Detected SF – Square Feet N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

<b>Table 6.10.1: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
J-1	2x2 Ceiling tile – grey worm & dot	1 <sup>st</sup> floor boys bathroom	Miscellaneous	NAD
J-2	2x2 Ceiling tile – grey worm & dot	1 <sup>st</sup> floor boys bathroom	Miscellaneous	NAD
J-3	2x2 Ceiling tile – grey stucco	1 <sup>st</sup> floor office	Miscellaneous	NAD
J-4	2x2 Ceiling tile – grey stucco	1 <sup>st</sup> floor office	Miscellaneous	NAD
J-5a	12” Floor tile – orange	1 <sup>st</sup> floor office area	Miscellaneous	NAD
J-5b	Floor tile mastic – yellow	1 <sup>st</sup> floor office area	Miscellaneous	NAD
J-6a	12” Floor tile – orange	1 <sup>st</sup> floor office area	Miscellaneous	NAD

**Table 6.10.1: Analytical Results Table**

Sample No	Material Description	Sample Location	Material Type	Results
J-6b	Floor tile mastic – yellow	1 <sup>st</sup> floor office area	Miscellaneous	NAD
J-7	Spray on Ceiling popcorn – white w/ black specs	1 <sup>st</sup> floor main room	Surfacing	NAD
J-8	Spray on Ceiling popcorn – white w/ black specs	1 <sup>st</sup> floor fire safety room	Surfacing	NAD
J-9	Spray on Ceiling popcorn – white w/ black specs	1 <sup>st</sup> floor fire safety room	Surfacing	NAD
J-10	Spray on Ceiling popcorn – white w/ black specs	1 <sup>st</sup> floor main room	Surfacing	NAD
J-11	Spray on Ceiling popcorn – white w/ black specs	1 <sup>st</sup> floor main room	Surfacing	NAD
J-12	Drywall/ joint compound	1 <sup>st</sup> floor office area	Miscellaneous	NAD
J-13	Drywall/ joint compound	1 <sup>st</sup> floor main room	Miscellaneous	NAD
J-14a	Vinyl covebase – black	2 <sup>nd</sup> floor next to elevator	Miscellaneous	NAD
J-14b	Covebase mastic – clear	2 <sup>nd</sup> floor next to elevator	Miscellaneous	NAD
J-15a	Vinyl covebase – black	2 <sup>nd</sup> floor wall across from elevator	Miscellaneous	NAD
J-15b	Covebase mastic – clear	2 <sup>nd</sup> floor wall across from elevator	Miscellaneous	NAD
J-16	Planetarium screen – white	2 <sup>nd</sup> floor on planetarium ceilings	Miscellaneous	NAD
J-17	Planetarium screen – white	2 <sup>nd</sup> floor on planetarium ceilings	Miscellaneous	NAD
J-18a	Plaster – base	Basement windows	Surfacing	NAD
J-18b	Plaster – skim	Basement windows	Surfacing	NAD
J-19a	Plaster – base	Basement windows	Surfacing	NAD
J-19b	Plaster – skim	Basement windows	Surfacing	NAD
J-20	TSI debris	Basement floors	Miscellaneous	NAD
J-21	TSI debris	Basement ground	Miscellaneous	NAD
J-22	Transite	Around basement windows	Miscellaneous	NAD
J-23	Transite	Around basement windows	Miscellaneous	NAD
J-24	Exterior door caulking	Front exterior door	Miscellaneous	NAD
J-25	Exterior door caulking	Front exterior door	Miscellaneous	NAD
J-26	Exterior window caulking	Rear original window	Miscellaneous	NAD
J-27	Exterior window caulking	Front left original window	Miscellaneous	NAD
J-28	Staircase tread – grey	1 <sup>st</sup> floor staircase	Miscellaneous	NAD
J-29	Staircase tread – grey	1 <sup>st</sup> floor staircase	Miscellaneous	NAD
J-30	Plaster – skim	Basement window	Surfacing	NAD
J-31	Plaster – base	Basement window	Surfacing	NAD
Notes: NAD – No Asbestos Detected				

The Lead Based Paint screening for the Planetarium included 22 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

**6.11 (K) OLD M.I.S. BUILDING**

A total of 51 bulk samples were collected from the Old MIS Building.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

<b>Table 6.11.1. Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
<b>THERMAL SYSTEM INSULATION</b>						
Boiler Insulation – white	Basement	K-19, K-20, K-41	60% C PS, 50% C	Damaged	Friable	100 SF
Boiler Insulation – brown	Basement	K-21, K-22, K-42	5% C, PS, 5% C	Damaged	Friable	100 SF
Pipe Fitting Insulation and debris – brown	Throughout Building	K-17, K-18, K-40	8% C PS, PS	Damaged	Friable	50 EA
Pipe Insulation – Outside wrap, White	Throughout Building	K-9, K-10, K-36	50% C PS, 30% C	Damaged	Friable	400 LF
Pipe Insulation and debris – Aircell, White	Throughout Building	K-11, K-12, K-37	40% C PS, PS	Damaged	Friable	400 LF
Tank Insulation – white powdery	Basement	K-13, K-14, K-38	40% C PS, PS	Damaged	Friable	40 SF
Tank Wrap – White, Powdery	Basement	K-15, K-16, K-39	5% C PS, PS	Damaged	Friable	2 SF
<b>SURFACING</b>						
Plaster – base	Throughout Building	K-1b, K-2b, K-7, K-8, K-31b, K-32b, K-33b, K-34b, K-35b	All NAD	Good	N/A	N/A
Plaster – skim	Throughout Building	K-1a, K-2a, K-31a, K-32a, K-33a, K-34a, K-35a	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
Door Caulking – white	All Exterior doors	K-29, K-30	3% C	Good	Category II non friable	50 LF
12” Floor tile – black	Kitchen	K-5a, K-6a	All NAD	Good	N/A	N/A
Floor Tile Mastic – black	Under bottom layer of floor tile on the wood subfloor	K-5b, K-6b	5% C	Good	Category II non friable	270 SF
4x8 Wallboard – white	Throughout Building	K-23, K-24	All NAD	Good	N/A	N/A
Window Glazing – tan	All Exterior Windows	K-25, K-26	All NAD	Good	N/A	N/A
Window Caulking – white	All Exterior Windows	K-27, K-28	All NAD	Good	N/A	N/A
Vinyl Flooring – blue and white	Kitchen	K-3, K-4	All NAD	Good	N/A	N/A
Asphalt Roof Shingles – black	Roof	Assumed	Assumed	Good	Category I non friable	2,150 SF

Table 6.11.1. Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
Notes: NAD – No Asbestos Detected SF – Square Feet LF – Linear Feet EA – Each PS – Positive Stop N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

Table 6.11.1: Analytical Results Table				
Sample No	Material Description	Sample Location	Material Type	Results
K-1a	Plaster – skim	Outside wall between room 3 and room 1	Surfacing	NAD
K-1b	Plaster – base	Outside wall between room 3 and room 1	Surfacing	NAD
K-2a	Plaster – skim	Hallway outside room 4	Surfacing	NAD
K-2b	Plaster – base	Hallway outside room 4	Surfacing	NAD
K-3	Vinyl Flooring – blue and white	Kitchen top layer	Miscellaneous	NAD
K-4	Vinyl Flooring – blue and white	Kitchen top layer	Miscellaneous	NAD
K-5a	12” Floor tile – black	Kitchen bottom layer	Miscellaneous	NAD
K-5b	Floor tile mastic – black	Under bottom layer floor tile on wood subfloor.	Miscellaneous	5 % Chrysotile
K-6a	12” Floor tile – black	Kitchen bottom layer	Miscellaneous	NAD
K-6b	Floor tile mastic – black	Under bottom layer floor tile on wood subfloor	Miscellaneous	5 % Chrysotile
K-7	Plaster – base	Basement stairwell and walls	Surfacing	NAD
K-8	Plaster – base	Basement stairwell and walls	Surfacing	NAD
K-9	Pipe insulation – outside wrap, white	Hot water line in basement	TSI	50 % Chrysotile
K-10	Pipe insulation – outside wrap, white	Hot water line in basement	TSI	PS
K-11	Pipe insulation – aircell, white	Hot water line in basement	TSI	40 % Chrysotile
K-12	Pipe insulation – aircell, white	Hot water line in basement	TSI	PS
K-13	Tank wrap – white powdery	Boiler expansion tank in basement	TSI	40% Chrysotile
K-14	Tank wrap – white powdery	Boiler expansion tank in basement	TSI	PS
K-15	Tank wrap – white powdery	End cap of expansion tank in basement	TSI	5 % Chrysotile
K-16	Tank wrap – white powdery	End cap of expansion tank in basement	TSI	PS
K-17	Pipe fitting insulation –brown	Hot water line in basement and crawlspace	TSI	8 % Chrysotile
K-18	Pipe fitting insulation –brown	Hot water line in basement and crawlspace	TSI	PS
K-19	Boiler Insulation – white	Inside boiler cabinet	TSI	60 % Chrysotile
K-20	Boiler Insulation – white	Inside boiler cabinet	TSI	PS
K-21	Boiler Insulation – brown	On boiler in basement	TSI	5 % Chrysotile
K-22	Boiler Insulation – brown	On boiler in basement	TSI	PS
K-23	4x8 Wallboard – white	Ceiling located above pull	Miscellaneous	NAD

Sample No	Material Description	Sample Location	Material Type	Results
		down door in attic		
K-24	4x8 Wallboard – white	West side exterior wall in attic	Miscellaneous	NAD
K-25	Window glazing – tan	Exterior window outside room 4	Miscellaneous	NAD
K-26	Window glazing – tan	Exterior window outside room 2	Miscellaneous	NAD
K-27	Window caulking – white	Exterior window outside room 4	Miscellaneous	NAD
K-28	Window caulking – white	Exterior window outside room 2	Miscellaneous	NAD
K-29	Door caulking – white	Front door	Miscellaneous	3 % Chrysotile
K-30	Door caulking – white	Back door	Miscellaneous	PS
K-31a	Plaster – skim	Room 5	Surfacing	NAD
K-31b	Plaster – base	Room 5	Surfacing	NAD
K-32a	Plaster – skim	Room 1	Surfacing	NAD
K-32b	Plaster – base	Room 1	Surfacing	NAD
K-33a	Plaster – skim	Room 2	Surfacing	NAD
K-33b	Plaster – base	Room 2	Surfacing	NAD
K-34a	Plaster – skim	Hallway	Surfacing	NAD
K-34b	Plaster – base	Hallway	Surfacing	NAD
K-35a	Plaster – skim	Room 5	Surfacing	NAD
K-35b	Plaster – base	Room 5	Surfacing	NAD
K-36	Pipe insulation- outside wrap, white	Hot water line in basement	TSI	30% Chrysotile
K-37	Pipe insulation – aircell, white	Hot water line in basement	TSI	PS
K-38	Tank wrap – white powdery	Boiler expansion tank in basement	TSI	PS
K-39	Tank wrap – white powdery	End cap of expansion tank in basement	TSI	PS
K-40	Pipe fitting insulation – brown	Hot water line in crawlspace	TSI	PS
K-41	Boiler Insulation – white solid formed	Inside boiler cabinet	TSI	50% Chrysotile
K-42	Boiler insulation – brown	On boiler in basement	TSI	5% Chrysotile
Notes: NAD – No Asbestos Detected    TSI – Thermal System Insulation    Positive Stop – Rule for Analyzing Samples N/A – Non-Applicable				

The Lead Based Paint screening included 33 XRF readings. Table 6.11.3 summarizes the positive results of the LBP screening. The lead based paint datasheets are included as Appendix B.

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading (mg/cm <sup>2</sup> )	LBP (Y or N)
K-4	wood	wall	white	kitchen	1.9	yes
K-5	drywall	wall	white	kitchen	1.9	yes
K-6	wood	door frame	white	kitchen	1.1	yes
K-7	wood	door	white	room 2	1.9	yes
K-8	ceramic	sink	white	kitchen	9.9	yes

**Table 6.11.3: Summary of Positive XRF Results**

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading (mg/cm <sup>2</sup> )	LBP (Y or N)
K-10	ceramic	tile	black	bathroom	7.9	yes
K-11	wood	window frame	white	room 5	1.9	yes
K-12	metal	radiator	white	room 5	0.8	yes
K-17	ceramic	fireplace	black	room 1	5.5	yes
K-18	wood	fireplace mantel	white	room 1	2.5	yes
K-20	wood	door	white	exterior of main entrance	3.7	yes
K-21	wood	door	white	door leading to back porch	2.7	yes
K-26	wood	door frame	white	exterior of main entrance	4.3	yes
K-27	wood	window sill	white	exterior of main entrance	2.4	yes

Based on the results of the LBP screening, it was determined that the following surfaces in Old M.I.S. Building contain LBP:

- Walls, doors, door frames and door components, window frames and window components, and radiators painted white located throughout the house. A total of three radiators located throughout house contain lead based paint.
- Black and white bathroom wall tiles, fire place tiles, and sinks contain lead.
- Door frames and door components and window frames and window components painted white located on exterior of house. A total of eighteen wood windows and two wooden doors were found positive.

All painted surfaces containing lead were found to be in damaged conditions.

## 6.12 (L) TAX OFFICE

A total of 58 bulk samples were collected from Tax Office.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

**Table 6.12.2: Homogenous Materials Summary Table**

Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
<b>THERMAL SYSTEM INSULATION</b>						
Encap Insulation	Mechanical Room	L-1, L-2, L-3, L-4	All NAD	Good	N/A	N/A
Pipe Fitting Insulation	Mechanical Room	L-14, L-15, L-16	All NAD	Damaged	N/A	N/A
Breeching Wrap	Mechanical Room	L-5, L-6, L-7	All NAD	Good	N/A	N/A
<b>SURFACING</b>						
Plaster – base	Throughout the building	L-30, L-31, L-32, L-55, L-56	All NAD	Good	N/A	N/A
Plaster – skim	Throughout the building	L-27, L-28, L-29, L-53, L-54	All NAD	Good	N/A	N/A



<b>Table 6.12.2: Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
<b>MISCELLANEOUS</b>						
Carpet Mastic – yellow	Throughout the building	L-44, L-45, L-46	All NAD	Good	N/A	N/A
1x1 Ceiling Tile - spline	Throughout the building	L-41, L-42, L-43	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – dots	Throughout the building	L-57, L-58	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – grooved	Throughout the building	L-8, L-9, L-10	All NAD	Good	N/A	N/A
2x4 Ceiling Tile	Throughout the building	L-11, L-12 L-13	All NAD	Good	N/A	N/A
Covebase – brown	Throughout the building	L-21, L-22	All NAD	Good	N/A	N/A
Covebase – grey	Throughout the building	L-33, L-34	All NAD	Good	N/A	N/A
Door Caulk	Mechanical Room (Exterior)	L-37, L-38	3%C, PS	Good	Category I non friable	1 EA
Drywall/ Joint Compound	Throughout the building	L-25, L-26	All NAD	Good	N/A	N/A
12” Floor Tile – light brown w/ specs	Throughout the building	L-49, L-50	All NAD	Good	N/A	N/A
12” Floor Tile – off white	Throughout the building	L-17, L-18, L-47	3%C, PS PS	Good	Category I non friable	9,000 SF
Mastic – black	Throughout the building	L-19, L-20, L-48	8%C, PS PS	Good	Category I non friable	9,000 SF
Mastic – brown	Throughout the building	L-23, L-24	All NAD	Good	N/A	N/A
Mastic – white	Throughout the building	L-35, L-36	All NAD	Good	N/A	N/A
Mastic – yellow	Throughout the building	L-51, L-52	All NAD	Good	N/A	N/A
Terrazzo Flooring	Throughout the building	L-39, L-40	All NAD	Good	N/A	N/A
Roofing material	Roof	Not Sampled	Assumed	Good	Category I non friable	Unknown
Fire Doors	1 <sup>st</sup> floor Mechanical Room and 2 <sup>nd</sup> Floor Room 38	Not Sampled	Assumed	Good	Category II non-friable	3 EA
Notes: NAD – No Asbestos Detected SF – Square Feet EA – Each PS – Positive Stop N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

<b>Table 6.12.1: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>

**Table 6.12.1: Analytical Results Table**

Sample No	Material Description	Sample Location	Material Type	Results
L-1	Endcap insulation	Mechanical room 6" pipes	Thermal System Insulation	NAD
L-2	Endcap insulation	Mechanical room 6" pipes	Thermal System Insulation	NAD
L-3	Endcap insulation	Mechanical room 6" pipes	Thermal System Insulation	NAD
L-4	Endcap insulation	Mechanical room 6" pipes	Thermal System Insulation	NAD
L-5	Breeching wrap	Mechanical room HVAC unit	Thermal System Insulation	NAD
L-6	Breeching wrap	Mechanical room HVAC unit	Thermal System Insulation	NAD
L-7	Breeching wrap	Mechanical room HVAC unit	Thermal System Insulation	NAD
L-8	2x2 ceiling tile – grooved	2nd floor	Miscellaneous	NAD
L-9	2x2 ceiling tile – grooved	2nd floor	Miscellaneous	NAD
L-10	2x2 ceiling tile – grooved	2nd floor	Miscellaneous	NAD
L-11	2x4 ceiling tile	Elevator room by mechanical room	Miscellaneous	NAD
L-12	2x4 ceiling tile	Elevator room by mechanical room	Miscellaneous	NAD
L-13	2x4 ceiling tile	Elevator room by mechanical room	Miscellaneous	NAD
L-14	Pipe fitting insulation	Mechanical room – vertical pipe next to exterior exit door	Thermal System Insulation	NAD
L-15	Pipe fitting insulation	Mechanical room – vertical pipe next to exterior exit door	Thermal System Insulation	NAD
L-16	Pipe fitting insulation	Mechanical room – vertical pipe next to ext. Exit door	Thermal System Insulation	NAD
L-17	12" floor tile – off white	Elevator room by mechanical room	Miscellaneous	3% Chrysotile
L-18	12" floor tile – off white	Corridor by elevator/ mechanical room	Miscellaneous	NAD
L-19	Mastic – black	Beneath l-17	Miscellaneous	8% Chrysotile
L-20	Mastic – black	Beneath l-18	Miscellaneous	NAD
L-21	Covebase – brown	Elevator room	Miscellaneous	NAD
L-22	Covebase – brown	Corridor by elevator room	Miscellaneous	NAD
L-23	Mastic – brown	Behind l-21	Miscellaneous	NAD
L-24	Mastic – brown	Behind l-22	Miscellaneous	NAD
L-25	Drywall/ joint compound	Elevator room by mechanical room	Miscellaneous	NAD
L-26	Drywall/ joint compound	Storage closet beneath stairs by mechanical room	Miscellaneous	NAD
L-27	Plaster – skim	Storage closet beneath stairs by mechanical room	Surfacing	NAD
L-28	Plaster – skim	Storage closet beneath stairs by mechanical room	Surfacing	NAD
L-29	Plaster – skim	Corridor by mechanical room	Surfacing	NAD
L-30	Plaster – base	Storage closet beneath stairs by mechanical room	Surfacing	NAD

**Table 6.12.1: Analytical Results Table**

Sample No	Material Description	Sample Location	Material Type	Results
L-31	Plaster – base	Storage closet beneath stairs by mechanical room	Surfacing	NAD
L-32	Plaster – base	Corridor by mechanical room	Surfacing	NAD
L-33	Covebase – grey	East entrance lobby	Miscellaneous	NAD
L-34	Covebase – grey	West entrance lobby	Miscellaneous	NAD
L-35	Mastic – white	Behind l-33	Miscellaneous	NAD
L-36	Mastic – white	Behind l-34	Miscellaneous	NAD
L-37	Door caulk	East entrance door to mechanical area	Miscellaneous	3%Chrysotile
L-38	Door caulk	East entrance door to mechanical area	Miscellaneous	NAD
L-39	Terrazzo flooring	East entrance lobby	Miscellaneous	NAD
L-40	Terrazzo flooring	West entrance lobby	Miscellaneous	NAD
L-41	1x1 ceiling tile – spline	Environmental corridor 1st floor	Miscellaneous	NAD
L-42	1x1 ceiling tile – spline	Taxes corridor 1st floor	Miscellaneous	NAD
L-43	1x1 ceiling tile – spline	Corridor by rest room 1st floor	Miscellaneous	NAD
L-44	Carpet mastic – yellow	1st floor vault	Miscellaneous	NAD
L-45	Carpet mastic – yellow	1st floor vault	Miscellaneous	NAD
L-46	Carpet mastic – yellow	2nd floor room 30 (mail room)	Miscellaneous	NAD
L-47	12" floor tile – off white	Beneath l-46	Miscellaneous	Positive Stop
L-48	Mastic – black	Beneath l-47	Miscellaneous	Positive Stop
L-49	12" floor tile – light brown w/ specs	Break room storage 2nd floor	Miscellaneous	NAD
L-50	12" floor tile – light brown w/ specs	Break room kitchen 2nd floor	Miscellaneous	NAD
L-51	Mastic – yellow	Beneath l-49	Miscellaneous	NAD
L-52	Mastic – yellow	Beneath l-50	Miscellaneous	NAD
L-53	Plaster – skim	2nd floor stairs by elevator (stairs to roof)	Surfacing	NAD
L-54	Plaster – skim	2nd floor stairs by elevator (stairs to roof)	Surfacing	NAD
L-55	Plaster – base	2nd floor stairs by elevator (stairs to roof)	Surfacing	NAD
L-56	Plaster – base	2nd Fl Stairs by Elevator (stairs to roof)	Surfacing	NAD
L-57	2x2 ceiling tile – dots	1st floor vault	Miscellaneous	NAD
L-58	2x2 ceiling tile – dots	1st floor vault	Miscellaneous	NAD
Notes: NAD – No Asbestos Detected    Positive Stop – Rule for Analyzing Samples    N/A – Non-Applicable				

The Lead Based Paint screening for the Tax Office included 31 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

**6.13 (M) EMS STATION #1**

A total of 31 bulk samples were collected from the EMS Station #1 Building.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

<b>Table 6.13.2. Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
<b>SURFACING</b>						
Stucco – white	Throughout exterior above brick	M-21, M-22, M-31	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
Drywall/Joint Compound	Throughout Building	M-1, M-2	All NAD	Good	N/A	N/A
12” Floor tile – beige	Throughout Building	M-3a, M-4a	3%C	Good	Category I non friable	170 SF
Floor tile mastic – black	Throughout Building	M-3-B, M-4b	8%C	Good	Category II non friable	170 SF
12” Vinyl Flooring – brown & beige	Throughout Building	M-5, M-6	All NAD	Good	N/A	N/A
Carpet Mastic – yellow	Throughout Building	M-7, M-8	All NAD	Good	N/A	N/A
12” Floor Tile – white/beige	Throughout Building	M-9a, M-10-a	3%C	Good	Category I non friable	324 SF
Floor tile Mastic – black	Throughout Building	M-9b, M-10b	8%C	Good	Category II non friable	324 SF
Carpet Mastic – yellow	Throughout Building	M-11, M-12	All NAD	Good	N/A	N/A
White Cover on Fiberglass insulation	Throughout Building	M-13, M-14	All NAD	Good	N/A	N/A
2x2 Ceiling Tile – white worm hole	Throughout Building	M-15, M-16	All NAD	Good	N/A	N/A
Rubber Covebase – black	Throughout building except for rooms 4 and 5	M-17a, M-18a	All NAD	Good	N/A	N/A
Cove Base Mastic – yellow	Throughout building except for room 4 and 5	M-17b, M-18b	All NAD	Good	N/A	N/A
Rubber Covebase – blue	Room 4 and 5	M-19a, M-20a	All NAD	Good	N/A	N/A
Rubber Covebase Mastic – yellow	Room 4 and 5	M-19b, M-20b	All NAD	Good	N/A	N/A
Door Caulking – white	All Exterior Doors	M-23, M-24	All NAD	Good	N/A	N/A
Window Caulking –	All Exterior windows	M-25, M-26	All NAD	Good	N/A	N/A

Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
Tan with White paint						
Window Glazing – Grey	All Exterior Windows	M-27, M-28	All NAD	Good	N/A	N/A
Ceiling Tile – white w/ worm & dot	Storage room in Bay area	M-29, M-30	All NAD	Good	N/A	N/A
Built up Roofing with associated Mastics	Roof	Assumed	Assumed	Unknown	Category I non friable	4,000 SF
Vibration Dampers	Throughout building on HVAC System	Assumed	Assumed	Unknown	Category II non friable	Unknown
Notes: C – Chrysotile Fiber    NAD – No Asbestos Detected    SF – Square Feet    N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

Sample No	Material Description	Sample Location	Material Type	Results
M-1	Sheetrock/joint compound	Room 3 lobby	Miscellaneous	NAD
M-2	Sheetrock/joint compound	Room 4 kitchen	Miscellaneous	NAD
M-3a	12" Floor tile – beige	Room 5	Miscellaneous	3 % Chrysotile
M-3b	Floor tile mastic – underneath floor tile, black	Room 5 , under floor tile	Miscellaneous	8 % Chrysotile
M-4a	12" Floor tile –beige	Room 4 2 <sup>nd</sup> layer	Miscellaneous	3 % Chrysotile
M-4b	Floor tile mastic – underneath floor tile, black	Room 4 , under floor tile	Miscellaneous	8 % Chrysotile
M-5	Vinyl flooring – brown and beige, stone 12 inch floor tile pattern	Room 4 kitchen top layer	Miscellaneous	NAD
M-6	Vinyl flooring – brown and beige, stone 12 inch floor tile pattern	Room 4 kitchen top layer	Miscellaneous	NAD
M-7	Carpet mastic – yellow	Room 8	Miscellaneous	NAD
M-8	Carpet mastic – yellow	Room 8	Miscellaneous	NAD
M-9a	Floor tile – white/beige 12 inch floor tile	Room 8 under carpet	Miscellaneous	3 % Chrysotile
M-9b	Floor tile mastic – black, under floor tile	Room 8 under floor tile	Miscellaneous	8 % Chrysotile
M-10a	Floor tile – white/beige, 12 inch floor tile	Room 1	Miscellaneous	3 % Chrysotile
M-10b	Floor tile mastic – black, under floor tile	Room 1	Miscellaneous	8 % Chrysotile
M-11	Carpet mastic – yellow	Bath room 1 under blue carpet	Miscellaneous	NAD
M-12	Carpet mastic – yellow	Bath room 1 under blue carpet	Miscellaneous	NAD

<b>Table 6.13.1: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
M-13	White cover on fiberglass insulation	Room8	Miscellaneous	NAD
M-14	White cover on fiberglass insulation	Room 8	Miscellaneous	NAD
M-15	Ceiling tile – 2' by 2' white with worm hole pattern	Room 3 lobby	Miscellaneous	NAD
M-16	Ceiling tile – 2' by 2' white with worm hole pattern	Room 3 lobby	Miscellaneous	NAD
M-17a	Rubber cove base – black	Room 1	Miscellaneous	NAD
M-17b	Rubber cove base mastic – yellow	Room 1	Miscellaneous	NAD
M-18a	Rubber cove base – black	Room 6	Miscellaneous	NAD
M-18b	Rubber cove base mastic – yellow	Room 6	Miscellaneous	NAD
M-19a	Rubber cove base – blue	Room 4	Miscellaneous	NAD
M-19b	Rubber cove base mastic – yellow	Room 4	Miscellaneous	NAD
M-20a	Rubber cove base- blue	Room 4	Miscellaneous	NAD
M-20b	Rubber cove base mastic – yellow	Room 4	Miscellaneous	NAD
M-21	Exterior stucco	Front of building	Surfacing	NAD
M-22	Stucco exterior	Left side of building	Surfacing	NAD
M-23	Door caulking – white	Front door	Miscellaneous	NAD
M-24	Door caulking – white	Front door	Miscellaneous	NAD
M-25	Window caulking – tan with white paint	Front left window	Miscellaneous	NAD
M-26	Window caulking – tan with white paint	Side window	Miscellaneous	NAD
M-27	Window glazing- grey	Front left window	Miscellaneous	NAD
M-28	Window glazing – grey	Side window	Miscellaneous	NAD
M-29	Ceiling tile – white with worm hole and dot pattern	Storage room in bay area	Miscellaneous	NAD
M-30	Ceiling tile – white with worm hole and dot pattern	Storage room in bay area	Miscellaneous	NAD
M-31	Stucco exterior	Rear side of building	Surfacing	NAD
Notes: NAD – No Asbestos Detected    N/A – Non-Applicable				

The Lead Based Paint screening for the EMS Station#1 included 23 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

#### **6.14 (N) HANNIBAL BUILDING**

A total of 32 bulk samples were collected from Hannibal building.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

<b>Table 6.14.2: Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Approximate Quantity</b>
<b>SURFACING</b>						
Plaster – base	Throughout the building	N-10, N-12, N-14, N-24, N-26	All NAD	Good	N/A	N/A
Plaster – skim	Throughout the building	N-9, N-11, N-13, N-23, N-25	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
Carpet Mastic – yellow	Throughout the building	N-3, N-4	All NAD	Good	N/A	N/A
2x4 Ceiling Tile	Throughout the building	N-1, N-2	All NAD	Good	N/A	N/A
12" Floor Tile – white	Throughout the building	N-5, N-6	All NAD	Good	N/A	N/A
Covebase – black	Throughout the building	N-29, N-30	All NAD	Good	N/A	N/A
Drywall	Throughout the building	N-17a, N-18a	All NAD	Good	N/A	N/A
Joint Compound	Throughout the building applied on drywall	N-17b, N-18b	3%C, 3%C	Good	Friable	Applied over 12,000 SF of drywall
Mastic – black	Throughout the building under floor tiles	N-7, N-8	All NAD	Good	N/A	N/A
Mastic – yellow	Throughout the building behind covebase	N-15, N-16, N-19, N-20	All NAD	Good	N/A	N/A
Terrazzo Flooring	Throughout the building	N-21, N-22	All NAD	Good	N/A	N/A
Window Caulk – white	Throughout the exterior building	N-27, N-28	All NAD	Good	N/A	N/A
Notes: *A composite sample of drywall and joint compound indicated trace amount of asbestos. C – Chrysotile Fiber    NAD – No Asbestos Detected    N/A – Non-applicable    SF – Square Feet						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

<b>Table 6.14.1: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
N-1	2x4 ceiling tile	2nd fl corridor	Miscellaneous	NAD
N-2	2x4 ceiling tile	2nd fl corridor	Miscellaneous	NAD
N-3	Carpet mastic – yellow	2nd fl corridor	Miscellaneous	NAD
N-4	Carpet mastic – yellow	1st floor corridor by storage	Miscellaneous	NAD
N-5	12" floor tile – white	Beneath N-3	Miscellaneous	NAD
N-6	12" floor tile – white	Beneath N-4	Miscellaneous	NAD
N-7	Mastic – black	Under N-5	Miscellaneous	NAD
N-8	Mastic – black	Under N-6	Miscellaneous	NAD

<b>Table 6.14.1: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
N-9	Plaster – skim	2nd floor – closet 222	Surfacing	NAD
N-10	Plaster – base	2nd floor – closet 222	Surfacing	NAD
N-11	Plaster – skim	2nd floor – restroom 221	Surfacing	NAD
N-12	Plaster – base	2nd floor – restroom 221	Surfacing	NAD
N-13	Plaster – skim	2nd floor – closet 222	Surfacing	NAD
N-14	Plaster – base	2nd floor – closet 222	Surfacing	NAD
N-15	Mastic – yellow	2nd floor corridor by 222 – black covebase	Miscellaneous	NAD
N-16	Mastic – yellow	2nd floor corridor by 222 – black covebase	Miscellaneous	NAD
N-17a	Drywall	Room 218	Miscellaneous	NAD
N-17b	Joint compound	Room 218	Miscellaneous	3% Chrysotile
N-18a	Drywall	2nd floor – duct space	Miscellaneous	NAD
N-18b	Joint compound	2nd floor – duct space	Miscellaneous	3% Chrysotile
N-19	Mastic – yellow	2nd floor TSCA room 1 – grey covebase	Miscellaneous	NAD
N-20	Mastic – yellow	2nd floor TSCA room 1 – grey covebase	Miscellaneous	NAD
N-21	Terrazzo flooring	Stairs	Miscellaneous	NAD
N-22	Terrazzo flooring	Stair landing	Miscellaneous	NAD
N-23	Plaster – skim	1st floor, DRC – computer room 108	Surfacing	NAD
N-24	Plaster – base	1st floor, DRC – computer room 108	Surfacing	NAD
N-25	Plaster – skim	1st floor – room 112	Surfacing	NAD
N-26	Plaster – base	1st floor – room 112	Surfacing	NAD
N-27	Window caulk – white	Exterior building	Miscellaneous	NAD
N-28	Window caulk – white	Exterior building	Miscellaneous	NAD
N-29	Covebase – black	2nd floor corridor by 222	Miscellaneous	NAD
N-30	Covebase – black	2nd floor corridor by 215	Miscellaneous	NAD
N-31	Covebase – grey	2nd floor TSCA room	Miscellaneous	NAD
N-32	Covebase – grey	2nd floor TSCA room	Miscellaneous	NAD
Notes: NAD – No Asbestos Detected    N/A – Non-Applicable				

The Lead Based Paint screening included 18 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

### 6.15 (O) LANDFILL SCALE HOUSE

A total of 11 bulk samples were collected from Landfill Scale House.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.



Table 6.15.2. Homogenous Materials Summary Table						
Material Description	Material Location	Sample Numbers	Sample Results	Condition	NESHAP Category	Quantity
<b>SURFACING</b>						
Spray on Ceiling – popcorn texture	Throughout the Building	O-3,O-4, O-5 O-6,O-7	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
12” Vinyl Flooring – beige	All Bathrooms	O-1, O-2	All NAD	Good	N/A	N/A
Drywall	Throughout the Building	O-8, O-9	All NAD	Good	N/A	N/A
Door Caulking	Exterior Doors	O-10	All NAD	Good	N/A	N/A
Window Caulking	Exterior Windows	O-11	All NAD	Good	N/A	N/A
Vibration Dampers	On HVAC Units	Not Sampled	Assumed	Good	Category II non friable	2 EA
Roof penetration mastic – black	Roof	Not Sampled	Assumed	Good	Category I non friable	25 SF
Asphalt Roof Shingles – black	Entire Roof	Not Sampled	Assumed	Good	Category I non friable	1,500 SF
Notes: NAD – No Asbestos Detected SF – Square Feet EA – Each N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

Table 6.15.1: Analytical Results Table				
Sample No	Material Description	Sample Location	Material Type	Results
O-1	12” Vinyl flooring – beige	Men’s bathroom room 6	Miscellaneous	NAD
O-2	12” Vinyl flooring – beige	Women’s bathroom room 5	Miscellaneous	NAD
O-3	Spray on ceiling – white popcorn texture	Room 1	Surfacing	NAD
O-4	Spray on ceiling – white popcorn texture	Room 3	Surfacing	NAD
O-5	Spray on ceiling – white popcorn texture	Room 6	Surfacing	NAD
O-6	Spray on ceiling – white popcorn texture	Room 7	Surfacing	NAD
O-7	Spray on ceiling – white popcorn texture	Room 9	Surfacing	NAD
O-8	Drywall – grey and multicolor wallpaper	Room 1	Miscellaneous	NAD
O-9	Drywall – grey and multicolor wallpaper	Room 7	Miscellaneous	NAD
O-10	Door caulking – white	Exterior door room 9	Miscellaneous	NAD
O-11	Window caulking – white	Exterior window outside room 2	Miscellaneous	NAD
Notes: NAD – No Asbestos Detected				

The Lead Based Painting screening for the Landfill Scale House included 13 XRF readings. Results show no positive readings for lead based paint containing materials. The lead based paint datasheets are included as Appendix B.

**6.16 (P) LANDFILL MAINTENANCE BUILDING**

A total of 13 bulk samples were collected from the Landfill Maintenance Building.

The homogenous materials summary table describes each homogenous material category in terms of material type, location, associated sample numbers, analysis results, friability of each material category and estimated quantity of each positive homogenous material.

<b>Table 6.16.2. Homogenous Materials Summary Table</b>						
<b>Material Description</b>	<b>Material Location</b>	<b>Sample Numbers</b>	<b>Sample Results</b>	<b>Condition</b>	<b>NESHAP Category</b>	<b>Quantity</b>
<b>SURFACING</b>						
Spray on Insulation	Throughout Building	P-5, P-6, P-7, P-8, P-9, P-10, P-11	All NAD	Good	N/A	N/A
<b>MISCELLANEOUS</b>						
Ceiling Tile	Office 1 and break room	P-3, P-4	All NAD	Good	N/A	N/A
Door Caulking	All exterior doors	P-13	All NAD	Good	N/A	N/A
Window Caulking	All exterior windows	P-12	All NAD	Good	N/A	N/A
Vinyl Flooring	Office 1	P-1, P-2	All NAD	Good	N/A	N/A
Roof Paint Coating	Metal Roof	Assumed	Assumed	Good	Category I non friable	2,750 SF
Notes: NAD – No Asbestos Detected SF – Square Feet N/A – Non-Applicable						

The analytical results table describes the suspect material sampled, location of sampling, homogenous category (material type) and laboratory results.

<b>Table 6.1.1: Analytical Results Table</b>				
<b>Sample No</b>	<b>Material Description</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Results</b>
P-1	Vinyl flooring – beige	Office 1	Miscellaneous	NAD
P-2	Vinyl flooring – beige	Office 1	Miscellaneous	NAD
P-3	Ceiling tile – grey/blue	Break room	Miscellaneous	NAD
P-4	Ceiling tile – grey/blue	Break room	Miscellaneous	NAD
P-5	Spray on insulation – grey	Shop area	Surfacing	NAD
P-6	Spray on insulation – grey	Shop area	Surfacing	NAD
P-7	Spray on insulation – grey	Shop area	Surfacing	NAD
P-8	Spray on insulation – grey	Shop area	Surfacing	NAD
P-9	Spray on insulation – grey	Shop area	Surfacing	NAD
P-10	Spray on insulation – grey	Shop area	Surfacing	NAD
P-11	Spray on insulation – grey	Shop area	Surfacing	NAD
P-12	Exterior caulking – cream	Window outside break room	Miscellaneous	NAD
P-13	Exterior caulking – cream	Exterior door to break room	Miscellaneous	NAD
Notes: NAD – No Asbestos Detected				

The Lead Based Paint screening for the Landfill Maintenance Shop included 13 XRF readings. Based on the results of the LBP screening, it was determined that none of the painted surfaces contain lead. The lead based paint datasheets are included as Appendix B.

## **7.0 Recommendations**

### **ASBESTOS**

KCI recommends that Lenoir County develop and implement an Operation and Maintenance (O&M) plan for properly managing ACM in the 16 surveyed County owned buildings to assure compliance with regulations.

As a part of the O&M plan KCI recommends that Lenoir County perform the following:

1. Provide asbestos awareness training to the maintenance and custodial staff.
2. Perform periodic surveillance at least once a year of all the identified ACM in good condition to monitor for changes in its condition.
3. In buildings where accessible friable ACM is in damaged condition, KCI recommends that those areas be restricted until a response action is performed. The response action may include abating (removing) ACM material, repairing or encapsulating it.

### **LEAD BASED PAINT**

KCI recommends that the building components with lead paint be maintained such that there is no peeling, chipping or flaking paint.

During the renovation /demolition of any building component with LBP, KCI recommends that the contractor should follow OSHA "Lead in Construction" standard, in conjunction with dust control and containment to prevent lead contamination of the surrounding areas, and the use of personal protective clothing to protect worker health and safety.

## **8.0 Disclaimer**

This report has been prepared by KCI Technologies, Inc. exclusively for our Client and their Authorized Representatives. The findings and recommendations presented are based upon discussions with the Client of the present conditions, and may not necessarily indicate future conditions. KCI implies no warranty to the accuracy of information provided them by the Client or outside agents and transmitted herein.

Appendix A:  
Accreditation Credential Certificates



Tehsin T. Aurangabadwala  
5 Preakness Ct  
Owings Mills, MD 21117

95312

**North Carolina  
Asbestos Accreditation**

EXPIRATION			
01-15-2016			
DOB	SEX	HT	WT
09-23-1975	F	5'4"	160
CLASS	#	EXP	
INSPECTOR	12623	01-15	

# AEROSOL MONITORING & ANALYSIS, INC.

*This is to certify that*

**TEHSIN AURANGABADWALA**

*has met the attendance requirements and successfully completed  
the course entitled*

**8-Hour EPA AHERA Insp/Mgmt Planner Refresher**

*For Accreditation Under TSCA Title II*

01/30/2012

**Course Date**

01/30/2012

**Exam Date**

1/30/2013

**Expiration Date**

DAVID TRUMAN

**Principal Instructor**

*David Truman*

115991

**Certification No.**

VA115991

**Virainia Certification No.**

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# AEROSOL MONITORING & ANALYSIS, INC.

*This is to certify that*  
**DAVIDA JONES**

*has met the attendance requirements and successfully completed  
the course entitled*

**3-Day EPA AHERA Inspector**

*For Accreditation Under TSCA Title II*

01/03/2011 to 01/05/2011

**Course Date**

01/05/2011

**Exam Date**

1/5/2012

**Expiration Date**

ROBERTA SPRATT-RITTER

**Principal Instructor**



110116

**Certification No.**

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**Virginia Certification No.**

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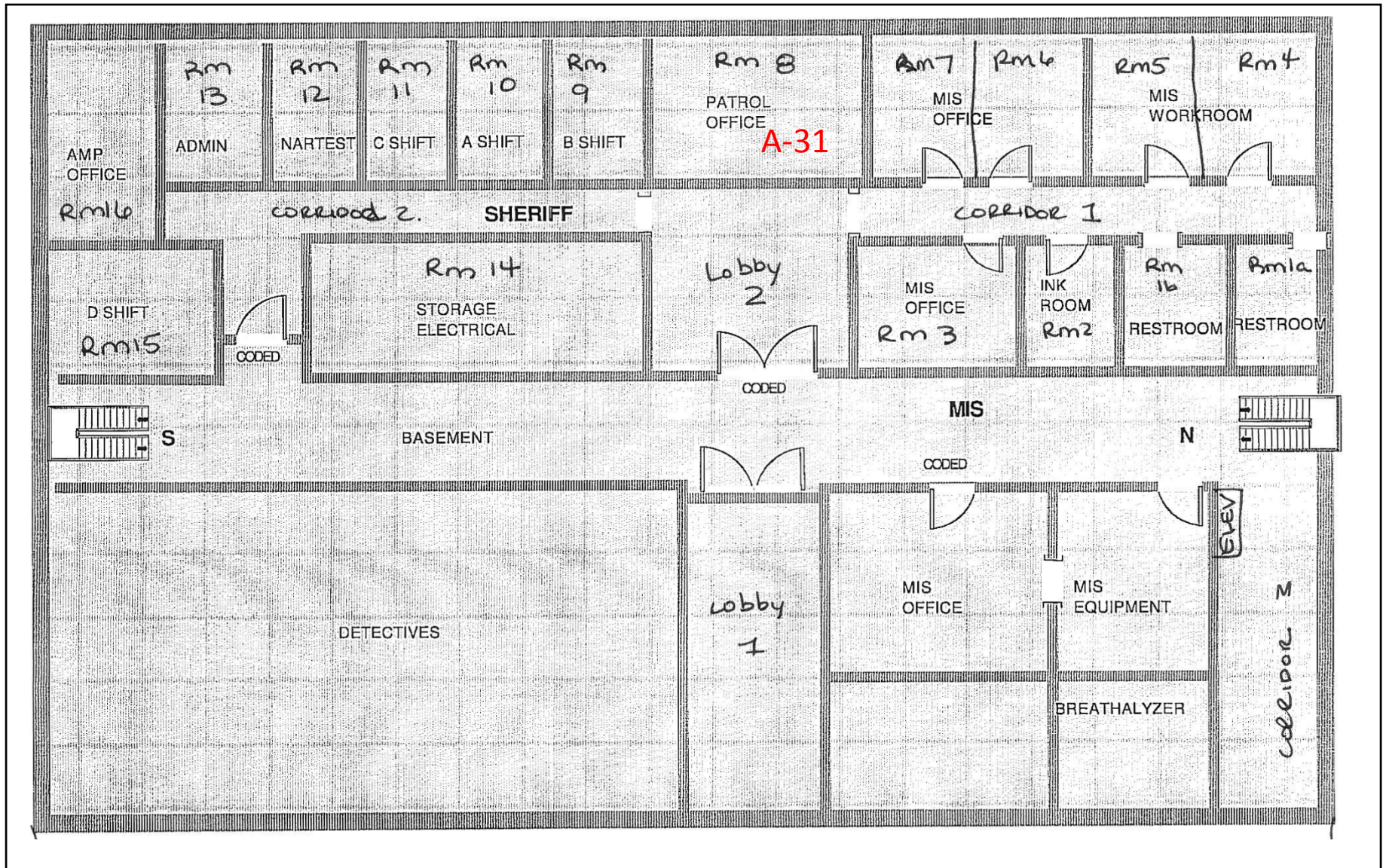
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**Appendix B:**  
**Building Floor Plans, Chain Of Custody Forms, Certificate Of Analysis Forms  
And Lead Based Paint Datasheets And Field Photographs For Each Building.**



**(A) COURT HOUSE**



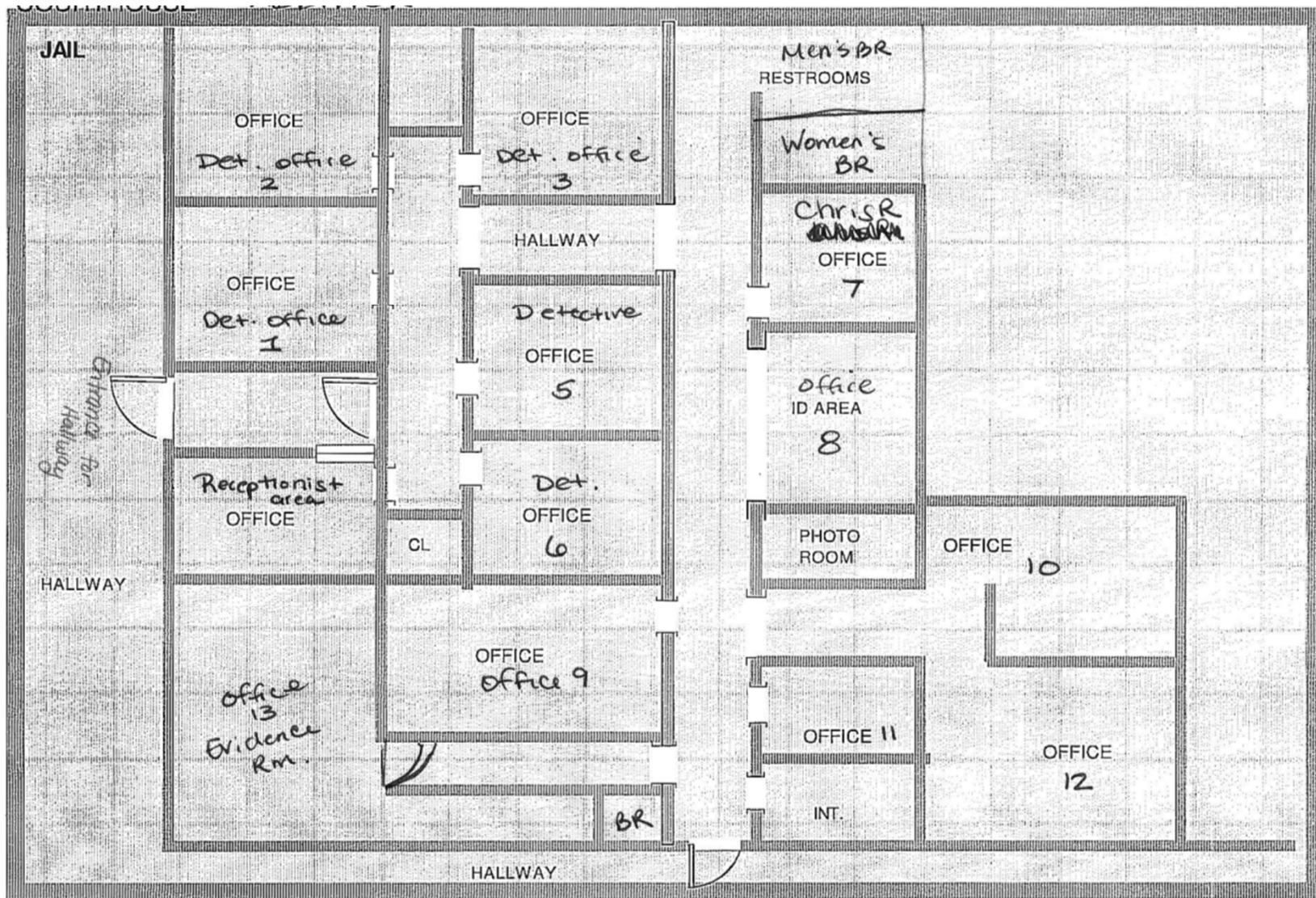
**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Courthouse Basement Floor (Old)**

**Notes:**  
 32,000 SF of Asbestos-Containing Floor Tile throughout Old Building  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



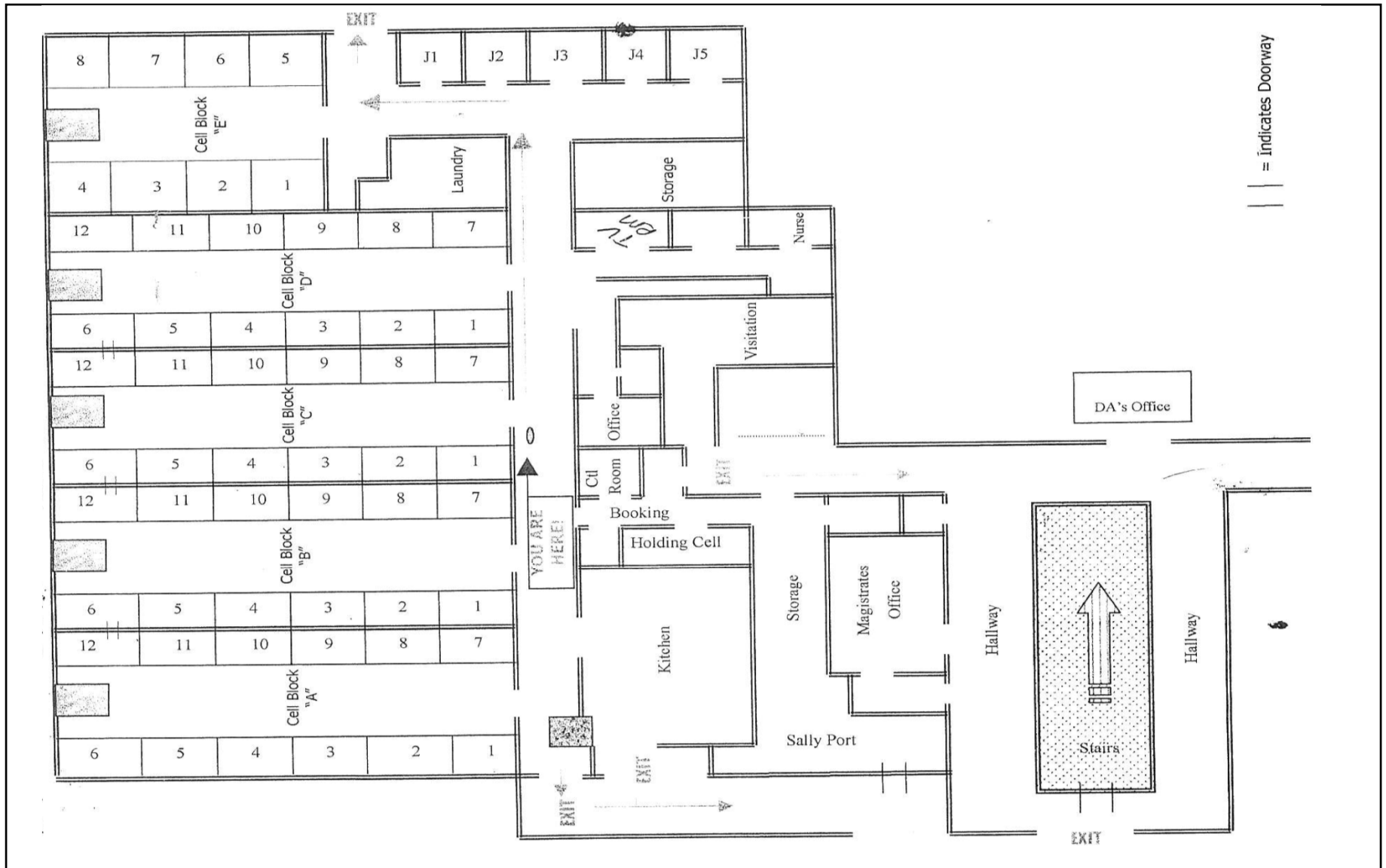


**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Courthouse Detectives Offices**

Notes:  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

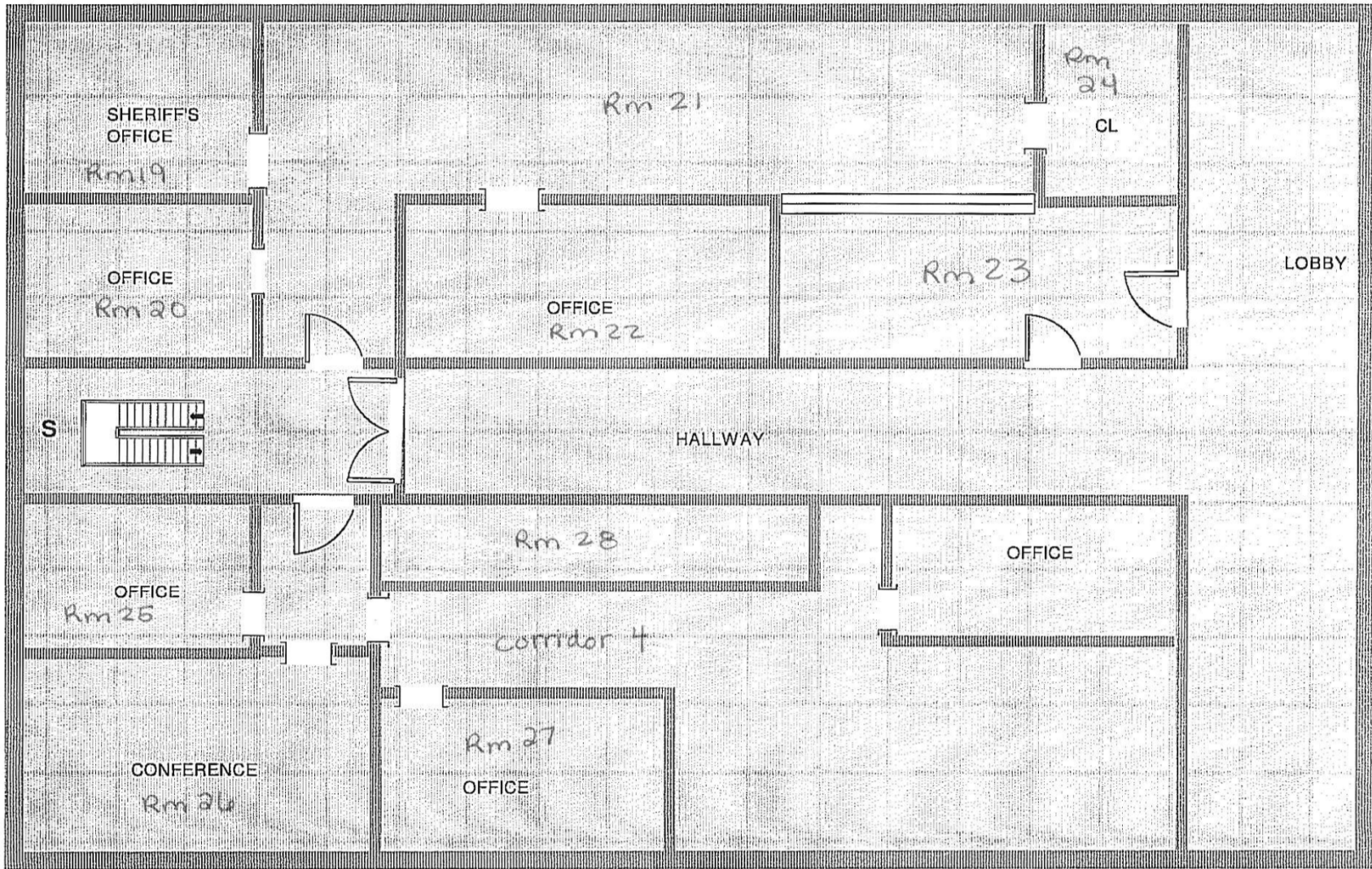
**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Courthouse Basement Jail**  
 Notes:  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502

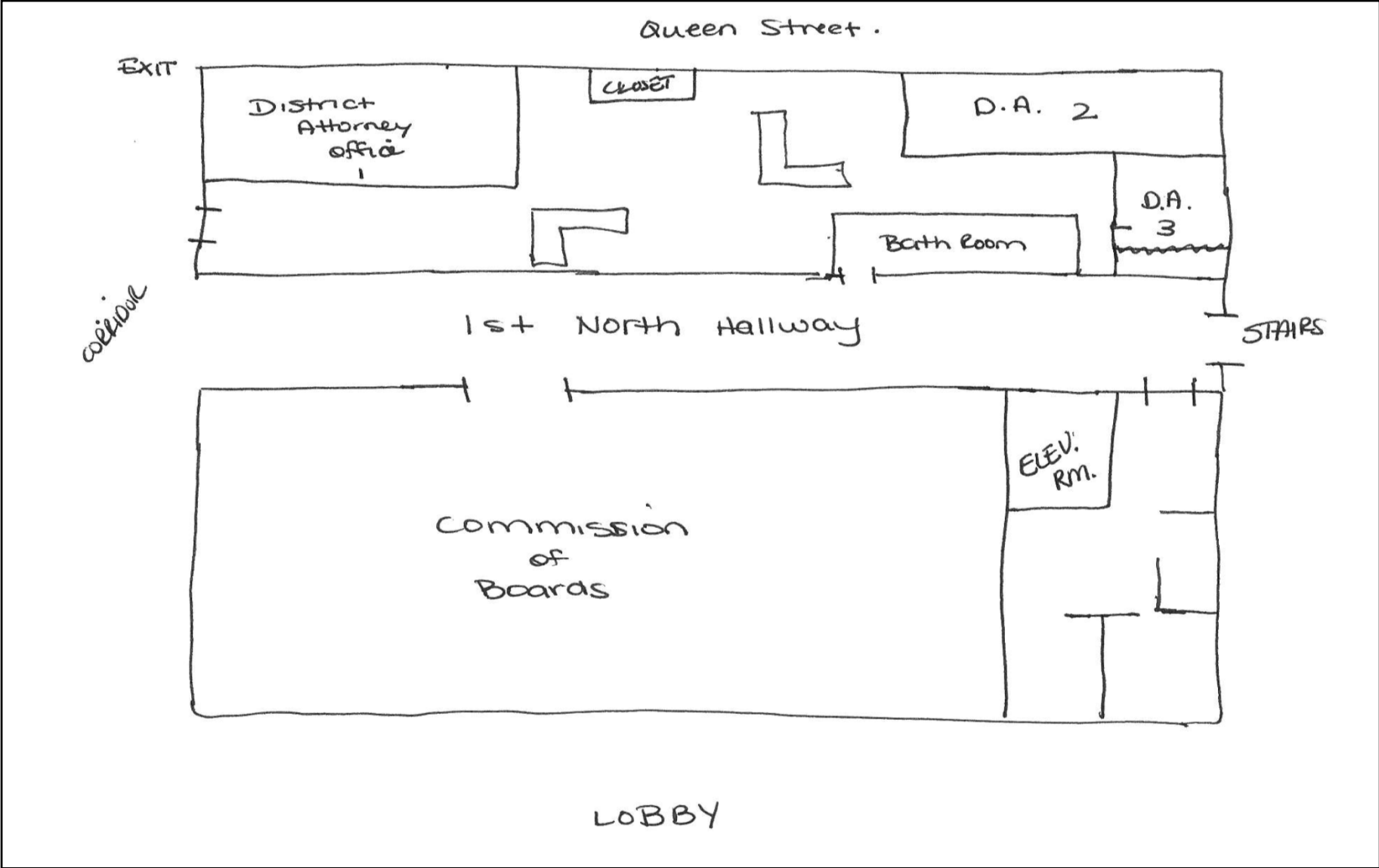


**Prepared by**  
 KCI Associates of North Carolina, P.A.  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Court House First Floor**

**Notes:**  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502

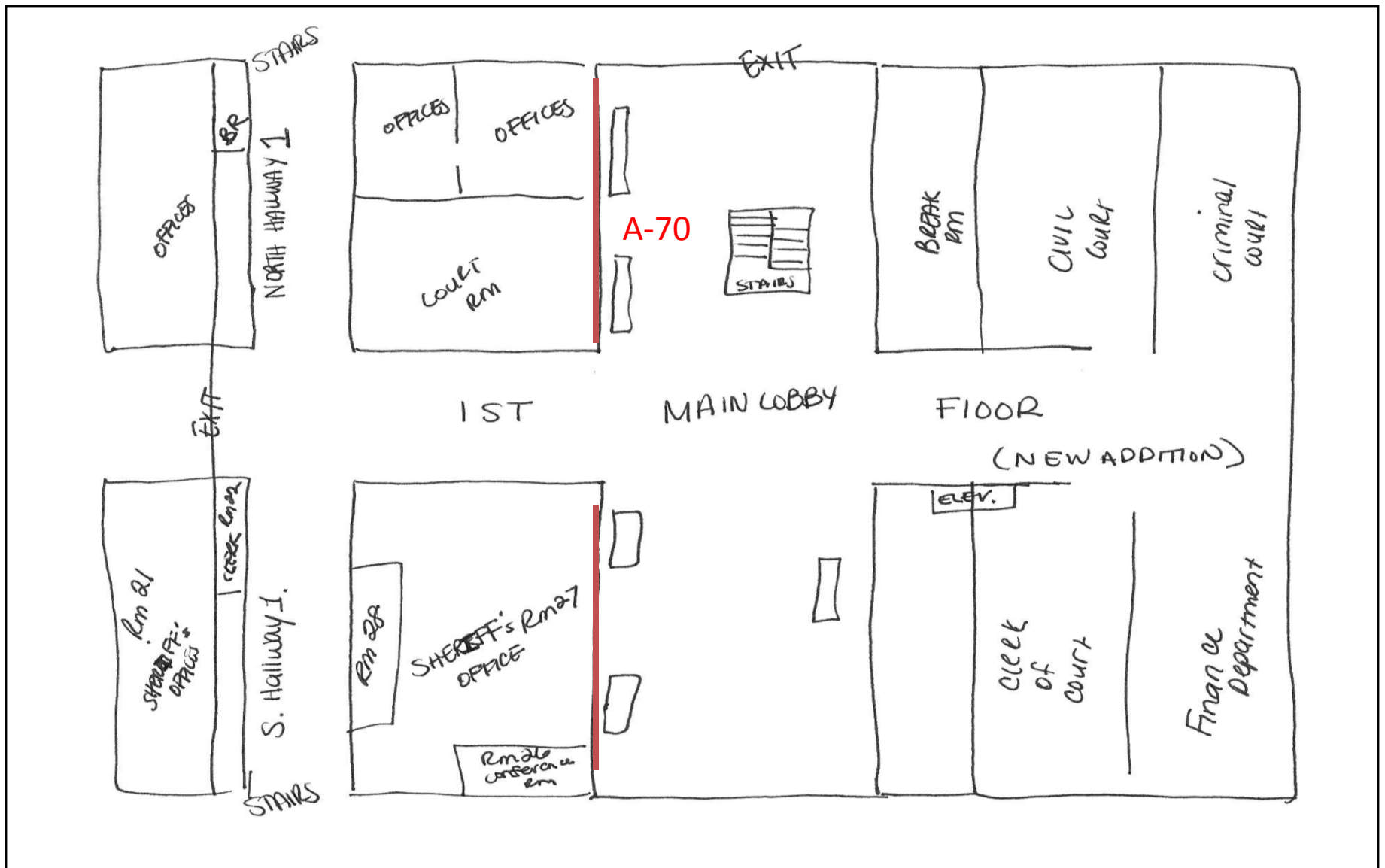


**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**1st Floor North Hallway**

Notes:  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502

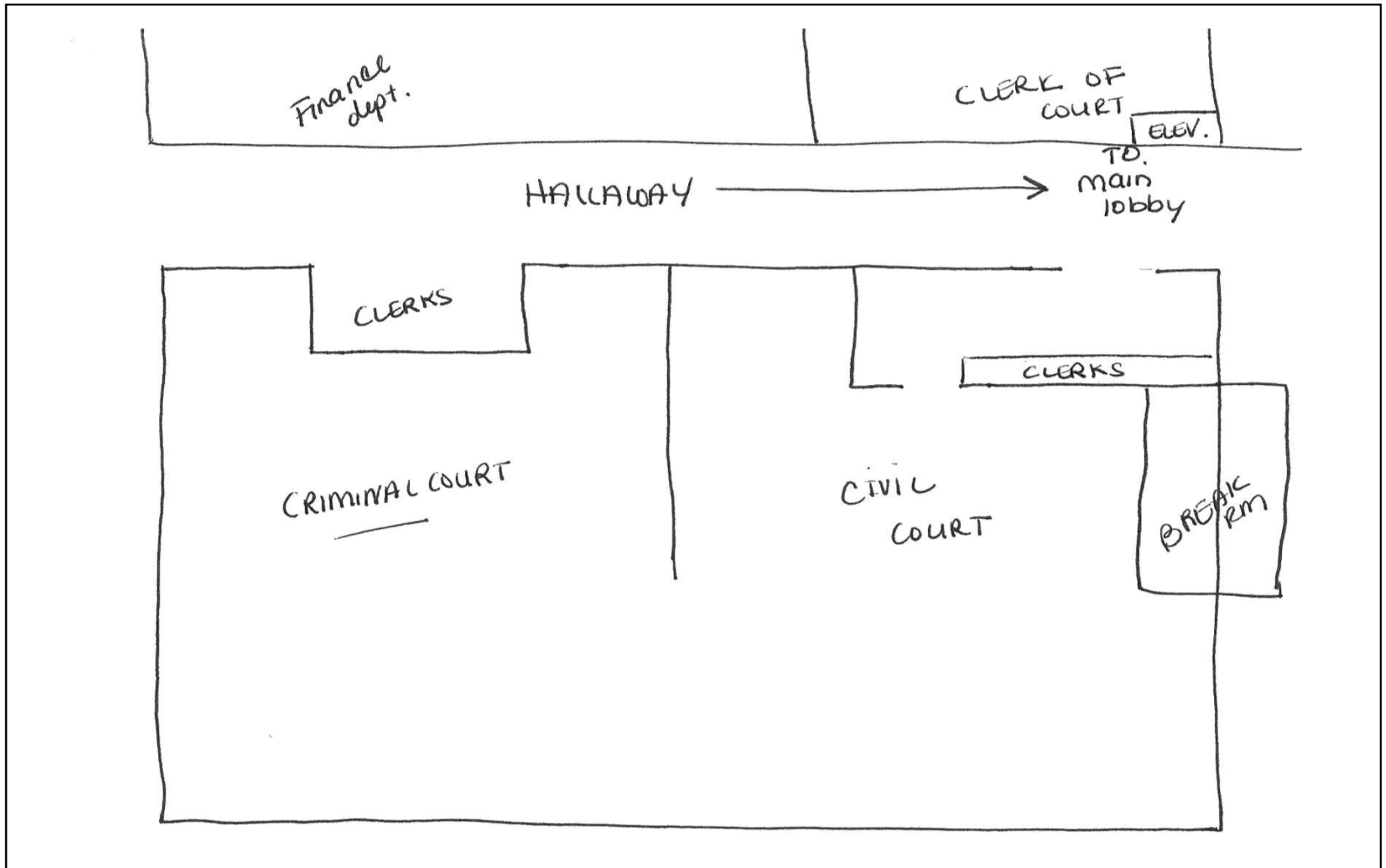


**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**1st Floor Main Lobby**

Notes:  
 ■ Lead Containing Materials  
 ■ Asbestos-Containing Window Glazing on Eight Windows  
 ■ Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502

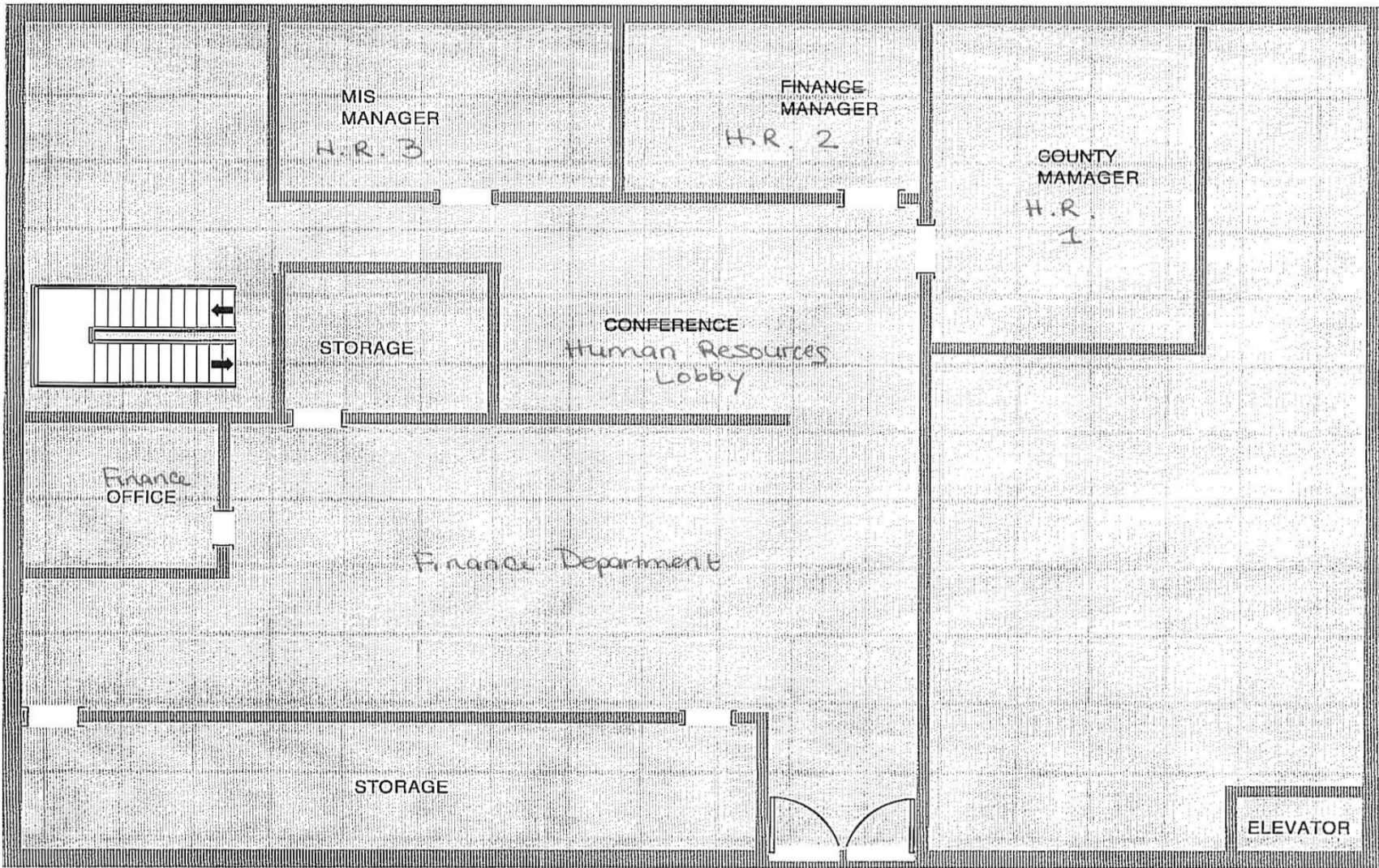


**Prepared by**  
 KCI Associates of North Carolina, P.A.  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**1st Floor New Addition**  
  
 Notes:  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



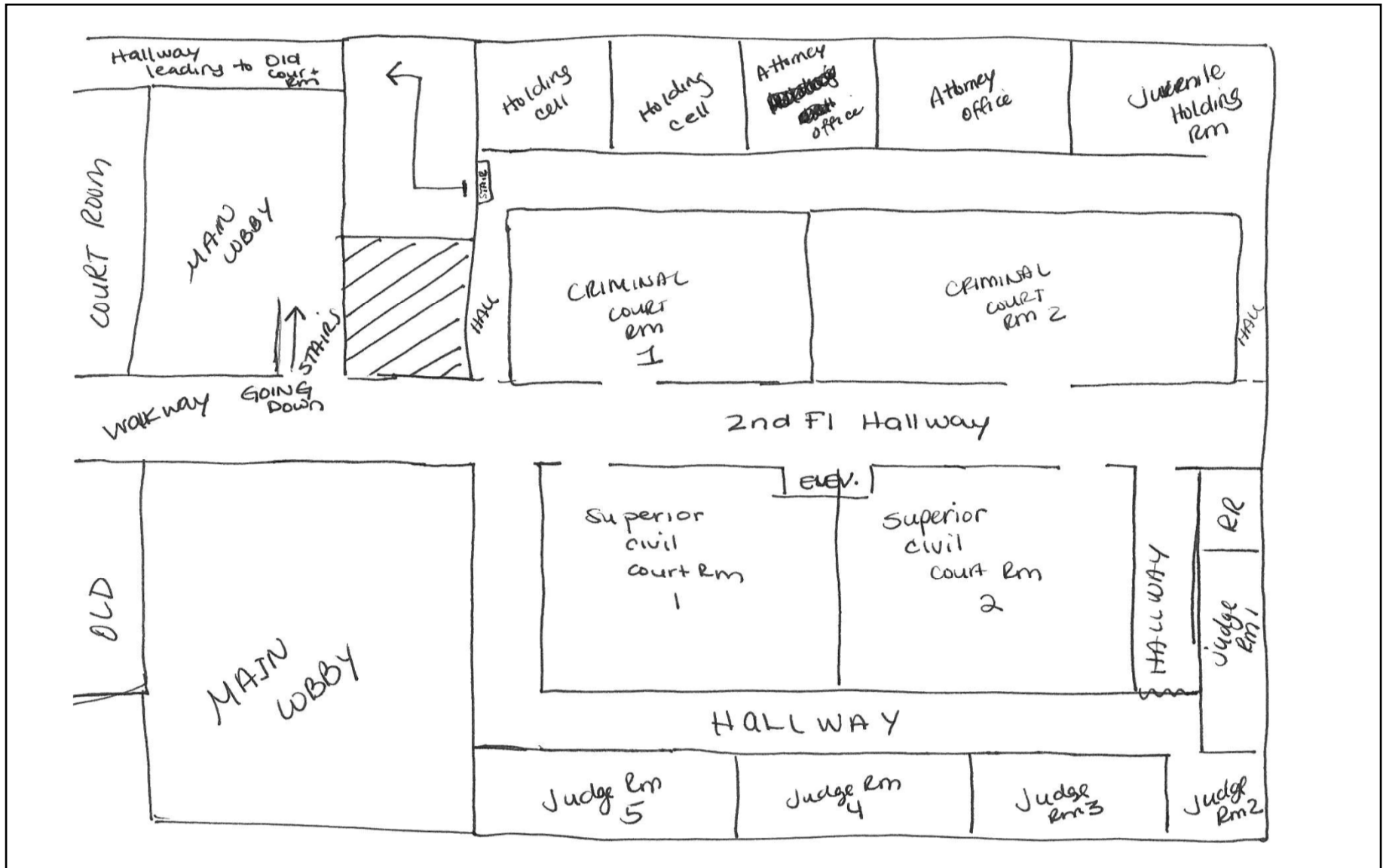


**Prepared by**  
 KCI Associates of North Carolina, P.A.  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**1<sup>st</sup> Floor New Addition**

**Notes:**  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502

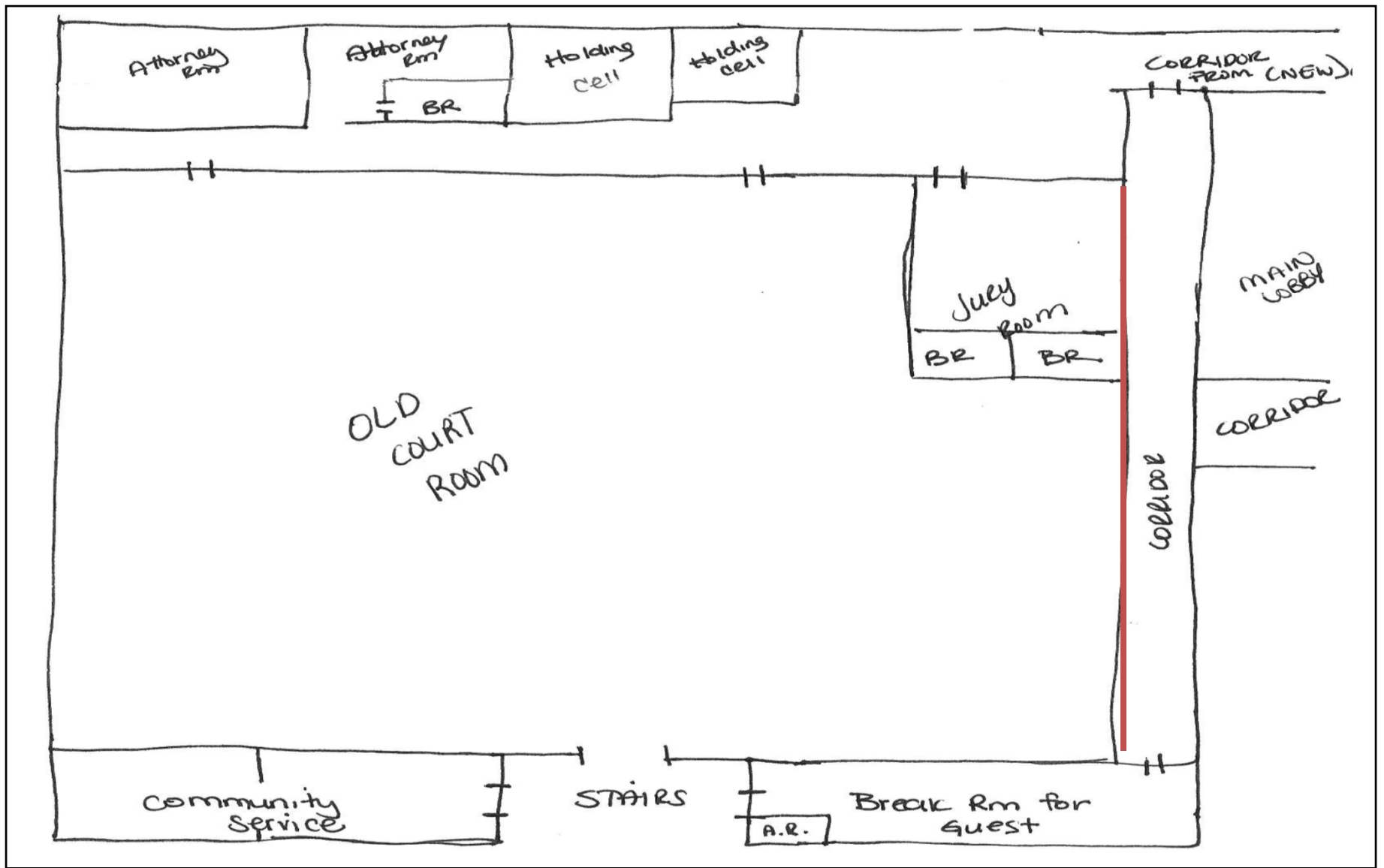


**Prepared by**  
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 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**2nd Floor New Addition**

Notes:  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

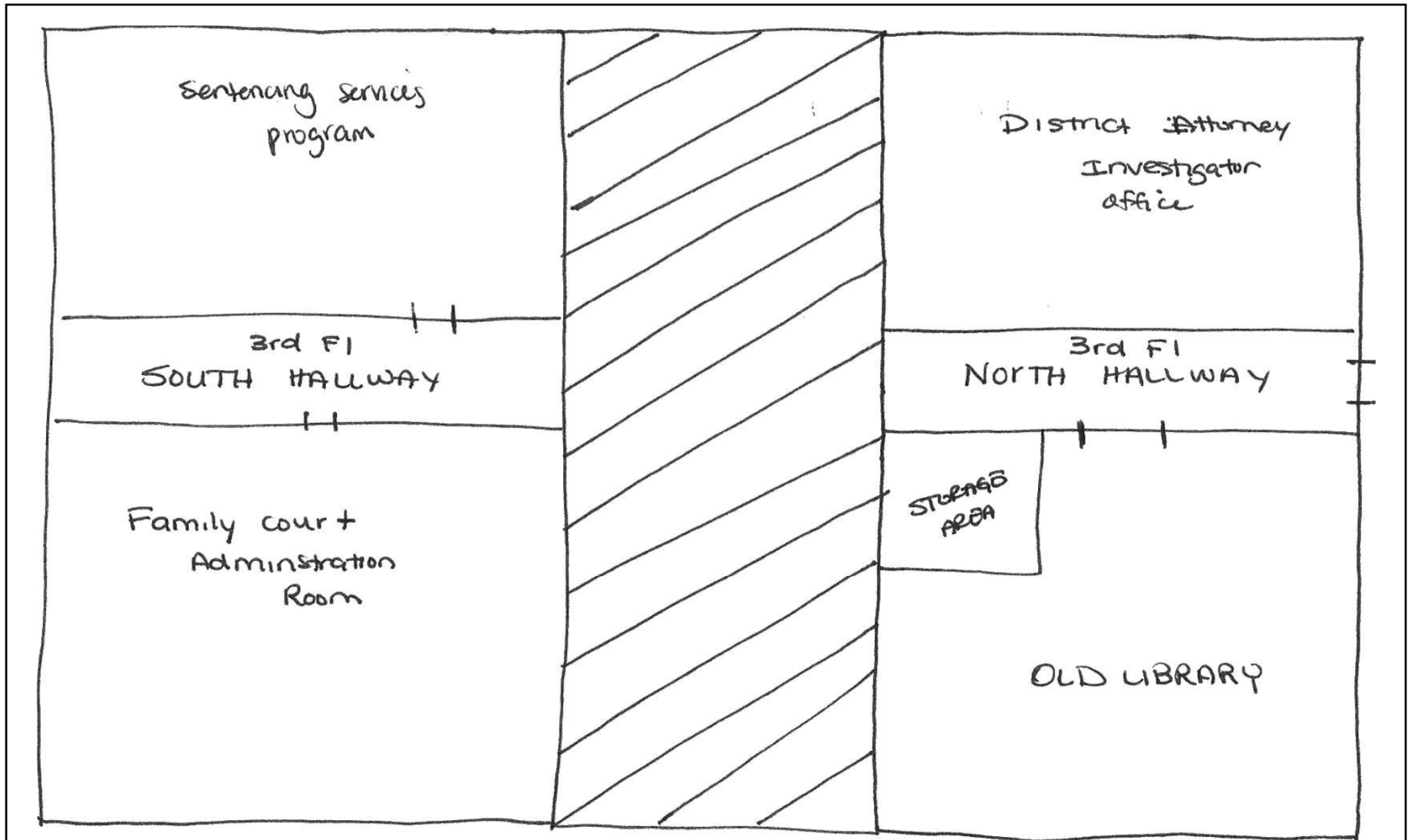
**Prepared for**  
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 130 South Queen Street,  
 Kinston, NC 28502



**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Old Court Room 2<sup>nd</sup> Floor**  
**Notes:**  
 ■ Lead Containing Materials  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

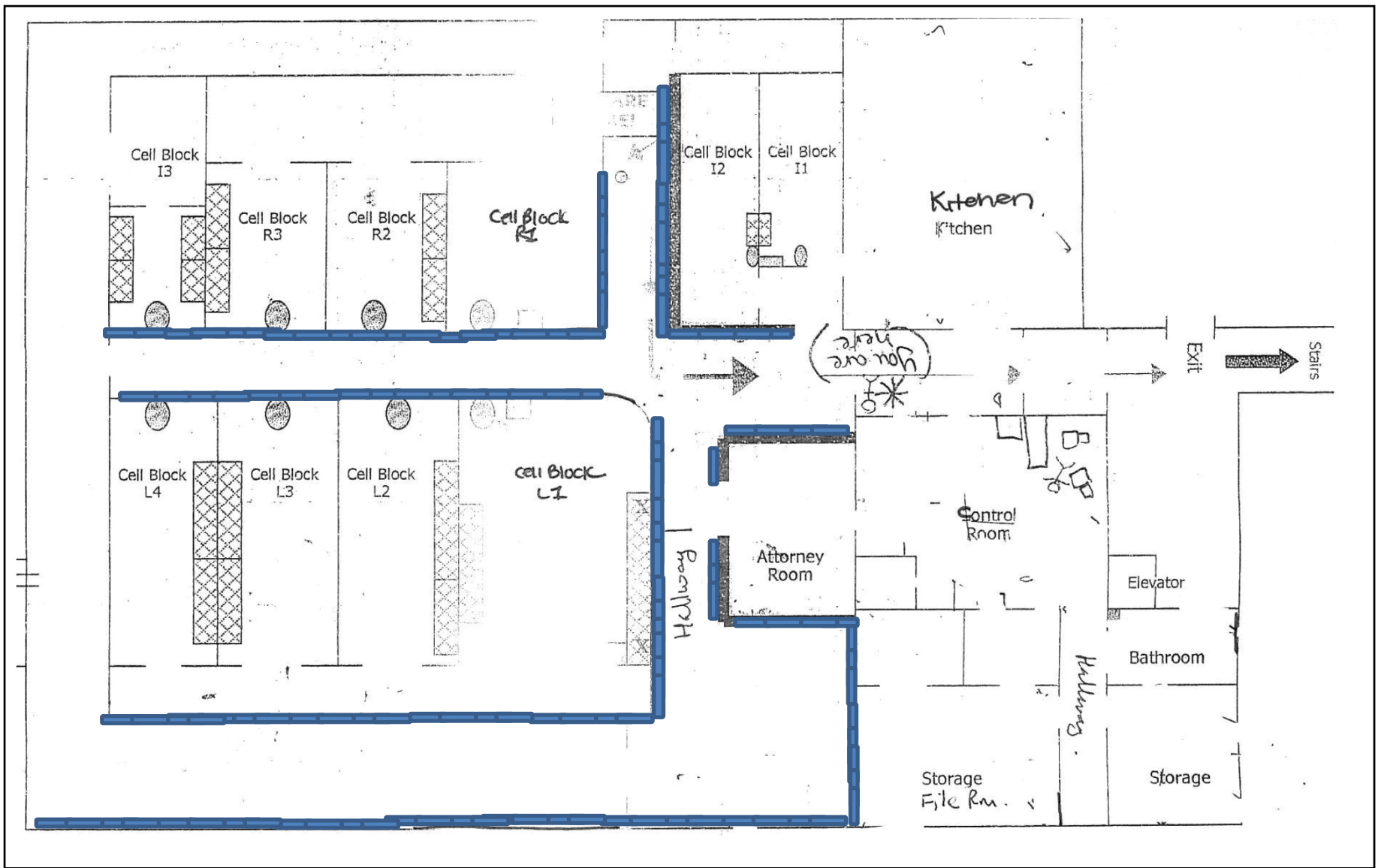
**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Prepared by**  
 KCI Associates of North Carolina, P.A.  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**3<sup>rd</sup> North and South Hallway**  
  
 Notes:  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Prepared by**  
 KCI Associates of North Carolina, P.A.  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Notes:**  
 ■ Lead Containing Material  
 160 SF of Black 9" Floor Tile in Storage Area  
 Pipe Fitting and Insulation throughout building  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200946

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone [ ]: 410.891.1726
4601 Six Forks Rd., 220	Fax [ ]: 410316.7935
Raleigh, NC 27609	Email [ ]: tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number:  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
	Please see attached Sampling Datasheet		
	Please apply positive stop as indicated.		
	Please apply positive stop for all skim plaster (7 samples) and all base plaster (7 samples)		

Total # of Samples

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/17/2012		1-19 9:30A

1200946



## ASBESTOS BULK SAMPLE SHEET

Job Order No: 15111236 Location: Court House. Date: 1/13/2012  
 Inspector: Tehsin Aurangabadwala Signature: \_\_\_\_\_ Page: 1 of 5

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
A-1	Boiler Insulation	Boiler Room				] PS
A-2	Boiler Insulation	Boiler Room				
A-3	Boiler Insulation	Boiler Rm.				
A-4	Pipe Insulation	Boiler Rm. (6" pipe)				] PS
A-5	Pipe Insulation	" " "				
A-6	Pipe Insulation	" " "				
A-7	Pipe fitting Insulation	Boiler Rm				] PS
A-8	Pipe fitting Insulation	" "				
A-9	Pipe fitting Insulation	" "				
A-11	2x4 Ceiling Tile	Basement Rm   Women RR.				] PS
A-12	2x4 Ceiling Tile	Basement Corridor 1-(Sheriff)				
A-13	12" Floor Tile- white	Basement Sheriff Rm 7.				] PS
A-14	12" Floor Tile- white	Basement Sheriff Rm 7				
A-15	Mastic - black	Beneath A-13				] PS
A-16	Mastic - black.	Beneath A-14.				
A-17	Plaster Skim	Basement Rm 8				] PS. Include A-37 & A-38, A-42, A-43
A-18	Plaster Skim	Basement Rm 8				
A-19	Plaster Skim	Basement Rm 8.				

1200946



## ASBESTOS BULK SAMPLE SHEET

Job Order No: 1511236 Location: Court House Date: 1/13/2012  
 Inspector: Tehsin Aurangabadwala Signature: \_\_\_\_\_ Page: 2 of 5

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
A-20	Plaster - base	Basement Rm 8				] PS. Include A-38, A-39
A-21	Plaster - base	" " "				
A-22	Plaster - base	" " "				
A-23	Covebase - light blue	" " "				] PS
A-24	Covebase - light blue.	" " "				
A-25	Mastic - tan	behind A-23				] PS
A-26	mastic - tan	behind A-24				
A-27	12" Floor Tile - Brown w/grey specks	Basement Rm 8				] PS
A-28	12" Floor Tile - Brown w/grey specks	" " "				
A-29	Mastic - black	Beneath A-27				] PS
A-30	Mastic - black.	Beneath A-28				
A-31	Floor Tile (2nd layer)	Beneath A-27				] PS
A-32	" " " "	Beneath - A-28.				
A-33	Drywall / Joint Compd.	Basement Rm 11 (Wall)				] PS.
A-34	" " "	" " " "				
A-36	Plaster - Skim	Basement Rm 11 Ceiling				] Include with A-17 to A-19 for PS
A-37	Plaster - Skim	" " "				
A-38	Plaster - base.	" " "				- Include with A-20 to A-22



1200946



ASBESTOS BULK SAMPLE SHEET

Job Order No: 1511236 Location: Court House Date: 1/13/2012.  
 Inspector: Tehsin Aurangabadwala Signature: \_\_\_\_\_ Page: 3 of 5

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good/ Damaged	Quantity	Remarks
A-39	Plaster - base	Basement Rm 11 (Ceiling)				
A-40	Duct Seam Sealant - Beige	" " "				] PS
A-41	Duct Seam Sealant - Beige	" " "				
A-42	Plaster - Skim	Basement - Mech. Rm				] Include for PS.
A-43	Plaster - Skim	" " "				
A-44	Plaster - Base	" " "				] Include for PS.
A-45	Plaster - Base.	" " "				
A-46	Covebase - Black	Basement Rm 17				] PS
A-47	Covebase - Black	" " "				
A-48	Mastic - Yellow.	" " " behind Covebase				] PS
A-49	Mastic - Yellow	" " " "				
A-50	Mastic Yellow	Basement Rm 17 - beneath carpet				] PS
A-51	" "	" " " "				
A-52	Spray on material	On beams - Basement - Sally Post				] PS
A-53	" " "	" " " " "				
A-54	" " "	↓				
A-55	" " "	↓				
A-56	" " "	↓				

1200946



## ASBESTOS BULK SAMPLE SHEET

Job Order No: 15111236 Location: Court House. Date: 1/13/2012.Inspector: Tehsin Aurangabadwala. Signature: \_\_\_\_\_ Page: 4 of 5

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
A-57	12" Floor Tile - brown w/ yellow streaks	1st Floor Rm 24				] PS
A-58	12" Floor Tile - brown w/ yellow streaks.	1st Floor Rm 24 (Vault.)				] PS
A-59	Mastic - Yellow.	Beneath Carpet 1st Floor - Dist. Attorney Rm. (old Court)				] PS
A-60	Mastic - Yellow.	Beneath Carpet 1st Floor Dist. Att. Rm " "				] PS
A-61	Drywall / Joint Compd.	1st Floor - Civil Court (new).				] PS
A-62	Drywall / Joint Compd.	1st Floor Criminal Court (new)				] PS
A-63	Covebase - white	1st Floor Finance Dept. (new)				] PS
A-64	Covebase - white.	1st Floor Human Resources (new)				] PS
A-65	Drywall - brown	1st Floor - Finance Storage RR.				] PS
A-66	Drywall - brown.	1st Floor - Finance Storage RR.				] PS
A-67	Mastic - Yellow.	Below carpet 1st Floor Civil Court Rm 2 (new)				] PS
A-68	12" Floor Tile - grey w/ black specks	4th Floor Storage Rm.				] PS
A-69	12" Floor Tile - grey w/ black specks.	" " " "				] PS
A-70	Window Glazing - grey	Main Lobby - 1st Floor (old).	interior window			] PS
A-71	Window Glazing - grey	" "	"			] PS
A-72	Window Caulk - grey	" "	"			] PS
A-73	Window Caulk - grey	" "	"			] PS
A-74	Glaze - black	Main <sup>Entrance</sup> floor to Main Lobby.				] PS. with A-75



## ASBESTOS BULK SAMPLE SHEET

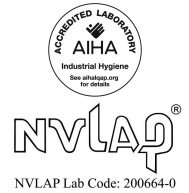
Job Order No: 15111236 Location: Court House. Date: 1/17/2012  
 Inspector: Tehsin Aurangabadwala Signature: \_\_\_\_\_ Page: 5 of 5

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good / Damaged	Quantity	Remarks
A-75	Glaze - black	On Main Entrance Door to Main lobby				
A-76	Caulk - grey	On Wall between concrete block - Main lobby (old side)				] PS
A-77	Caulk - grey	On Wall between concrete block - Main lobby (old)				] PS
A-78	Caulk - white	Exterior Wall (glass) across Main Entrance in Main lobby				] PS
A-79	Caulk - white	" " " "				] PS
A-80	Caulk - grey	Wall between Concrete block - Main lobby (new)				] PS
A-81	Caulk - grey	" " " "				] PS
A-82	Terrazzo - orange	1st Floor Main lobby (new) on wall				] PS
A-83	Terrazzo - orange	1st Floor Main lobby (new) on wall				] PS
A-84	Terrazzo - black	1st Floor - South Hallway stairway				] PS
A-85	Terrazzo - black	" " " "				] PS
A-86	Terrazzo - Tan - pink	1st Floor - North Hallway				] PS
A-87	Terrazzo - Tan - pink	" " " "				] PS
A-88	Caulk - grey	Exterior walls - between concrete blocks				] PS
A-89	Caulk - grey	" " " "				] PS
A-90	Caulk - white	Exterior Stairs.				] PS.
A-91	Caulk - white	" " " "				] PS.



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200946

**Analysis ID:** 1200946\_PL

**Date Received:** 1/19/2012

**Project:** 15111236 IHG-00 Courthouse

**Date Reported:** 1/19/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-1	Boiler insulation	20% Chrysotile		80% Other	Gray Fibrous Heterogeneous
1200946PLM_1					Teased
A-2	Boiler insulation	Not Analyzed			
1200946PLM_2					
A-3	Boiler insulation	Not Analyzed			
1200946PLM_3					
A-4	Pipe insulation	50% Chrysotile	40% Cellulose	10% Other	White Fibrous Heterogeneous
1200946PLM_4					Teased
A-5	Pipe insulation	Not Analyzed			
1200946PLM_5					
A-6	Pipe insulation	Not Analyzed			
1200946PLM_6					
A-7	Pipe fitting insulation	30% Chrysotile		70% Other	Gray Fibrous Heterogeneous
1200946PLM_7					Teased
A-8	Pipe fitting insulation	Not Analyzed			
1200946PLM_8					

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Ired Gulley (89)

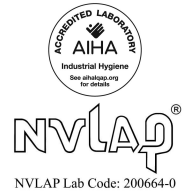
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200946

**Analysis ID:** 1200946\_PL

**Date Received:** 1/19/2012

**Project:** 15111236 IHG-00 Courthouse

**Date Reported:** 1/19/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-9	Pipe fitting insulation	Not Analyzed			
1200946PLM_9					
A-11	2x4 ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	10% Perlite 10% Other	White Fibrous Heterogeneous
1200946PLM_10					Teased
A-12	2x4 ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	10% Perlite 10% Other	White Fibrous Heterogeneous
1200946PLM_11					Teased
A-13	12" floor tile - white	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_12					Dissolved
A-14	12" floor tile - white	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_13					Dissolved
A-15	Mastic - black	None Detected	5% Cellulose	95% Other	Black Non Fibrous Heterogeneous
1200946PLM_14					Dissolved
A-16	Mastic - black	None Detected	5% Cellulose	95% Other	Black Non Fibrous Heterogeneous
1200946PLM_15					Dissolved
A-17	Plaster skim	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_16					Crushed

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Ired Gulley (89)

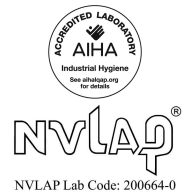
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200946

**Analysis ID:** 1200946\_PL

**Date Received:** 1/19/2012

**Project:** 15111236 IHG-00 Courthouse

**Date Reported:** 1/19/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-18	Plaster skim	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_17					Crushed
A-19	Plaster skim	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_18					Crushed
A-20	Plaster - base	None Detected		90% Other 10% Quartz	Brown Non Fibrous Heterogeneous
1200946PLM_19					Crushed
A-21	Plaster - base	None Detected		90% Other 10% Quartz	Brown Non Fibrous Heterogeneous
1200946PLM_20					Crushed
A-22	Plaster - base	None Detected		90% Other 10% Quartz	Brown Non Fibrous Heterogeneous
1200946PLM_21					Crushed
A-23	Covebase - light blue	None Detected		100% Other	Blue Non Fibrous Heterogeneous
1200946PLM_22					Dissolved
A-24	Covebase - light blue	None Detected		100% Other	Blue Non Fibrous Heterogeneous
1200946PLM_23					Dissolved
A-25	Mastic - tan	None Detected	3% Cellulose	97% Other	Tan Non Fibrous Heterogeneous
1200946PLM_24					Dissolved

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Ired Gulley (89)

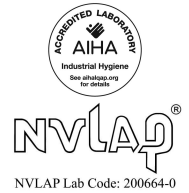
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200946

**Analysis ID:** 1200946\_PL

**Date Received:** 1/19/2012

**Project:** 15111236 IHG-00 Courthouse

**Date Reported:** 1/19/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-26	Mastic - tan	None Detected	3% Cellulose	97% Other	Tan Non Fibrous Heterogeneous
1200946PLM_25					Dissolved
A-27	12" floor tile - brown w/ gray specks	None Detected		100% Other	Brown Non Fibrous Heterogeneous
1200946PLM_26					Dissolved
A-28	12" floor tile - brown w/ gray specks	None Detected		100% Other	Brown Non Fibrous Heterogeneous
1200946PLM_27					Dissolved
A-29	Mastic - black	None Detected	5% Cellulose	95% Other	Black Non Fibrous Heterogeneous
1200946PLM_28					Dissolved
A-30	Mastic - black	None Detected	5% Cellulose	95% Other	Black Non Fibrous Heterogeneous
1200946PLM_29					Dissolved
A-31	Floor tile (2nd layer)	3% Chrysotile		97% Other	Tan Non Fibrous Heterogeneous
1200946PLM_30					Dissolved
A-32	Floor tile (2nd layer)	Not Analyzed			
1200946PLM_31					
A-33	Drywall / joint compd	None Detected	15% Cellulose	85% Other	Brown, White Fibrous Heterogeneous
1200946PLM_32	<i>drywall: none detect; joint compnd: none detect</i>				Teased

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Ired Gulley (89)

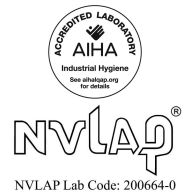
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200946

**Analysis ID:** 1200946\_PL

**Date Received:** 1/19/2012

**Project:** 15111236 IHG-00 Courthouse

**Date Reported:** 1/19/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-34	Drywall / joint compd	None Detected	15% Cellulose	85% Other	Brown, White Fibrous Heterogeneous
1200946PLM_33	<i>drywall: none detect; joint compnd: none detect</i>				Teased
A-36	Plaster - skim	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_35					Crushed
A-37	Plaster - base	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_36					Crushed
A-38	Plaster - base	None Detected		80% Other 20% Quartz	Gray Non Fibrous Heterogeneous
1200946PLM_37					Crushed
A-39	Plaster - base	None Detected		80% Other 20% Quartz	Gray Non Fibrous Heterogeneous
1200946PLM_38					Crushed
A-40	Duct seam sealant - beige	None Detected	3% Cellulose	97% Other	Beige Non Fibrous Heterogeneous
1200946PLM_39					Dissolved
A-41	Duct seam sealant - beige	None Detected	3% Cellulose	97% Other	Beige Non Fibrous Heterogeneous
1200946PLM_40					Dissolved
A-42	Plaster - skim	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_41					Crushed

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Analyst

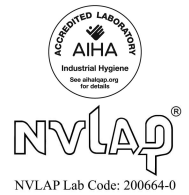
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Lab Sample ID	Lab Notes				Treatment
A-43	Plaster - skim	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_42					Crushed
A-44	Plaster - base	None Detected		80% Other 20% Quartz	Brown Non Fibrous Heterogeneous
1200946PLM_43					Crushed
A-45	Plaster - base	None Detected		80% Other 20% Quartz	Brown Non Fibrous Heterogeneous
1200946PLM_44					Crushed
A-46	Covebase - black	None Detected		100% Other	Black Non Fibrous Heterogeneous
1200946PLM_45					Dissolved
A-47	Covebase - black	None Detected		100% Other	Black Non Fibrous Heterogeneous
1200946PLM_46					Dissolved
A-48	Mastic - yellow	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Heterogeneous
1200946PLM_47					Dissolved
A-49	Mastic - yellow	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Heterogeneous
1200946PLM_48					Dissolved
A-50	Mastic - yellow	None Detected	3% Synthetic Fibers	97% Other	Yellow Non Fibrous Heterogeneous
1200946PLM_49					Dissolved

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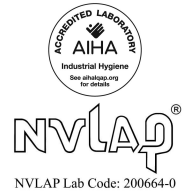
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-51	Mastic - yellow	None Detected	3% Synthetic Fibers	97% Other	Yellow Non Fibrous Heterogeneous
1200946PLM_50					Dissolved
A-52	Spray on material	None Detected	10% Cellulose 10% Fiber Glass	70% Other 10% Vermiculite	Brown Fibrous Heterogeneous
1200946PLM_51					Teased
A-53	Spray on material	None Detected	10% Cellulose 10% Fiber Glass	70% Other 10% Vermiculite	Brown Fibrous Heterogeneous
1200946PLM_52					Teased
A-54	Spray on material	None Detected	10% Cellulose 10% Fiber Glass	70% Other 10% Vermiculite	Brown Fibrous Heterogeneous
1200946PLM_53					Teased
A-55	Spray on material	None Detected	10% Cellulose 10% Fiber Glass	70% Other 10% Vermiculite	Brown Fibrous Heterogeneous
1200946PLM_54					Teased
A-56	Spray on material	None Detected	10% Cellulose 10% Fiber Glass	70% Other 10% Vermiculite	Brown Fibrous Heterogeneous
1200946PLM_55					Teased
A-57	12" floor tile - brown w/ yellow streaks	None Detected	5% Cellulose	95% Other	Brown Non Fibrous Heterogeneous
1200946PLM_56					Dissolved
A-58	12" floor tile - brown w/ yellow streaks	None Detected	5% Cellulose	95% Other	Brown Non Fibrous Heterogeneous
1200946PLM_57					Dissolved

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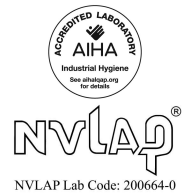
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-59	Mastic - yellow	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Heterogeneous
1200946PLM_58					Dissolved
A-60	Mastic - yellow	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Heterogeneous
1200946PLM_59					Dissolved
A-61	Drywall - joint compd	None Detected	8% Cellulose	92% Other	White Fibrous Heterogeneous
1200946PLM_60	drywall only				Teased
A-62	Drywall - joint compd	None Detected	15% Cellulose	85% Other	Brown, White Fibrous Heterogeneous
1200946PLM_61	drywall only				Teased
A-63	Covebase - white	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_62					Dissolved
A-64	Covebase - white	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_63					Dissolved
A-65	Drywall - brown	None Detected	15% Cellulose	85% Other	Brown, White Fibrous Heterogeneous
1200946PLM_64	drywall: none detect; joint compnd: none detect				Teased
A-66	Drywall - brown	None Detected	5% Cellulose	95% Other	Brown Fibrous Heterogeneous
1200946PLM_65	drywall only				Teased

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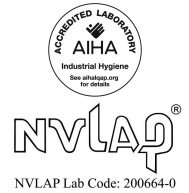
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-67	Mastic - yellow	<b>None Detected</b>	3% Cellulose	97% Other	Yellow Non Fibrous Heterogeneous
1200946PLM_66					Dissolved
A-68	12" floor tile - grey w/ black streaks	<b>None Detected</b>		100% Other	Gray Non Fibrous Heterogeneous
1200946PLM_67					Dissolved
A-69	12" floor tile - grey w/ black streaks	<b>None Detected</b>		100% Other	Gray Non Fibrous Heterogeneous
1200946PLM_68					Dissolved
A-70	Window glazing - grey	3% <b>Chrysotile</b>		97% Other	Gray Non Fibrous Heterogeneous
1200946PLM_69					Crushed
A-71	Window glazing - grey	<b>Not Analyzed</b>			
1200946PLM_70					
A-72	Window caulk - grey	<b>None Detected</b>		100% Other	Gray Non Fibrous Heterogeneous
1200946PLM_71					Ashed
A-73	Window caulk - grey	<b>None Detected</b>		100% Other	Gray Non Fibrous Heterogeneous
1200946PLM_72					Ashed
A-74	Glaze - black	<b>None Detected</b>		100% Other	Black Non Fibrous Heterogeneous
1200946PLM_73					Ashed

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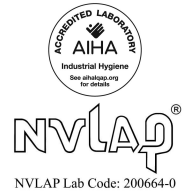
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-75	Glaze - black	None Detected		100% Other	Black Non Fibrous Heterogeneous
1200946PLM_74					Ashed
A-76	Caulk - grey	None Detected	3% Cellulose	97% Other	Gray Non Fibrous Heterogeneous
1200946PLM_75					Ashed
A-77	Caulk - grey	None Detected	3% Cellulose	97% Other	Gray Non Fibrous Heterogeneous
1200946PLM_76					Ashed
A-78	Caulk - white	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_77					Ashed
A-79	Caulk - white	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_78					Ashed
A-80	Caulk - grey	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200946PLM_79					Ashed
A-81	Caulk - grey	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200946PLM_80					Ashed
A-82	Terrazzo - orange	None Detected		100% Other	Orange Non Fibrous Heterogeneous
1200946PLM_81					Crushed

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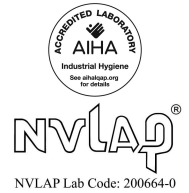
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-83	Terrazzo - orange	None Detected		100% Other	Orange Non Fibrous Heterogeneous
1200946PLM_82					Crushed
A-84	Terrazzo - black	None Detected		100% Other	Black Non Fibrous Heterogeneous
1200946PLM_83					Crushed
A-85	Terrazzo - black	None Detected		100% Other	Black Non Fibrous Heterogeneous
1200946PLM_84					Crushed
A-86	Terrazzo - tan - pink	None Detected		100% Other	Pink Non Fibrous Heterogeneous
1200946PLM_85					Crushed
A-87	Terrazzo - tan - pink	None Detected		100% Other	Pink Non Fibrous Heterogeneous
1200946PLM_86					Crushed
A-88	Caulk - grey	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200946PLM_87					Ashed
A-89	Caulk - grey	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200946PLM_88					Ashed
A-90	Caulk - white	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_89					Ashed

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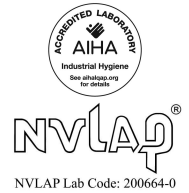
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
A-91	Caulk - white	None Detected		100% Other	White Non Fibrous Heterogeneous
1200946PLM_90					Ashed

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Ired Gulley (89)

Analyst

Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
A-1		SRM - 2579	Red	Calibration Test	1.20	NA
A-2		SRM - 2579	Red	Calibration Test	1.10	NA
A-3		SRM - 2579	Red	Calibration Test	1.10	NA
A-4	wood	door frame	cream	room 1 women's bathroom	0.00	no
A-5	wood	door	cream	room 1 women's bathroom	0.00	no
A-6	metal	door frame	cream	room 6	0.05	no
A-7	wood	frame	light cream	room 7	0.00	no
A-8	wood	door	blue	room 8	0.00	no
A-9	metal	door frame	blue	room 8	0.05	no
A-10	drywall	wall c	light blue	room 8	0.00	no
A-11	metal	door frame	dark tan	main entrance to lobby2	0.03	no
A-12	metal	door	cream	main entrance to lobby2	0.00	no
A-13	wood	window sill	white	room 13	0.00	no
A-14	plaster	wall a	green	mechanical room	0.09	no
A-15	plaster	wall b	tan	mechanical room	0.10	no
A-16	plaster	wall c	white	mechanical room hallway	0.00	no
A-17	metal	door	black	room 17	0.00	no
A-18	wood	door frame	white	room 17	0.00	no
A-19	metal	door frame	black	room 18	0.01	no
A-20	drywall	wall	white	room 18	0.00	no
A-21	concrete	wall d	white	corridor 3	0.00	no
A-22	brick	wall b	white	corridor 3	0.00	no
A-23	metal	bars	light tan	inside of cell block C	0.00	no
A-24	metal	door frame	dark tan	inside of cell block C	0.00	no
A-25	metal	concrete	light tan	inside of cell block C	0.00	no
A-26	metal	door	peach	inside of jail house kitchen basement	0.00	no
A-27	concrete	floor	gray	inside of jail house kitchen basement	0.04	no
A-28	wood	door	peach	office	0.00	no
A-29	drywall	wall	tan	office	0.00	no
A-30	drywall	wall	blue	next to holding cell	0.00	no
A-31	drywall	wall	white	Detectives Office 1	0.00	no
A-32	drywall	wall	gray	bathroom inside detective dept.	0.00	no
A-33	metal	door frame	dark gray	bathroom inside detective dept.	0.02	no
A-34	wood	door	dark gray	bathroom inside detective dept.	0.00	no
A-35	wood	window sill	tan	room 19	0.00	no
A-36	metal	door frame	tan	room 24	0.05	no
A-37	plaster	wall	tan	room 25	0.04	no
A-38	plaster	wall	white	attorney office	0.15	no
A-39		SRM - 2579	Red	Calibration Test	1.20	NA
A-40		SRM - 2579	Red	Calibration Test	1.20	NA
A-41		SRM - 2579	Red	Calibration Test	1.00	NA
A-42	metal	door frame	tan	civil court	0.02	no
A-43	drywall	wall d	light cream	civil court	0.00	no
A-44	drywall	wall b	pink	criminal court	0.00	no
A-45	wood	door	tan	E-100 - clerk of court	0.00	no
A-46	wood	door frame	tan	E-100 - clerk of court	0.00	no
A-47	drywall	wall	yellow	finance department	0.00	no
A-48	drywall	wall	red	finance department	0.00	no
A-49	wood	chair rail	white	finance department	0.00	no
A-50	wood	door	white	storage in finance dept.	0.00	no
A-51	wood	door frame	white	storage in finance dept.	0.00	no
A-52	drywall	wall a	green	office 1 human resources	0.00	no
A-53	metal	stairs	tan	stairway near office 3 human res.	0.00	no



**Lead Sample Datasheet**

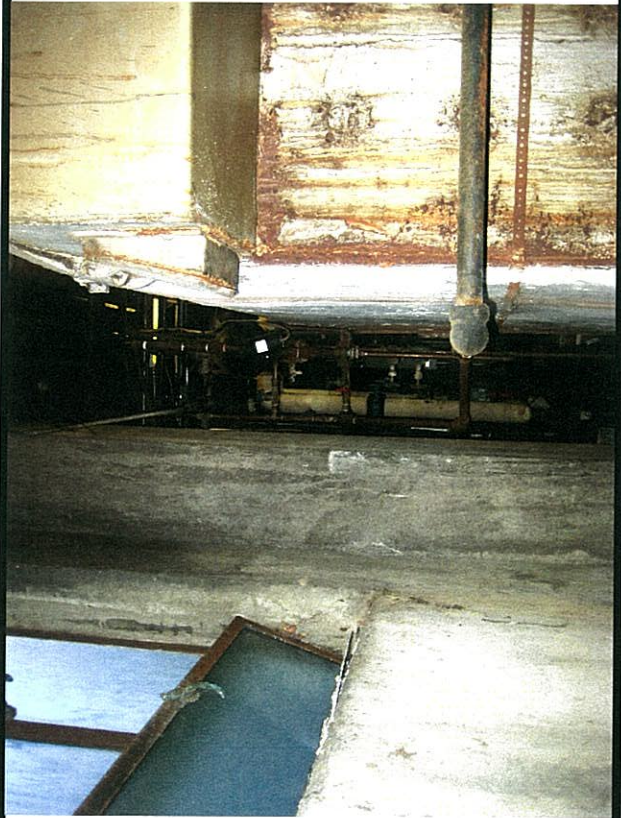
<b>Sample Number</b>	<b>Substrate</b>	<b>Component</b>	<b>Color</b>	<b>Location / Description</b>	<b>XRF Reading</b>	<b>LBP (Yor N)</b>
A-54	drywall	wall	tan	1st floor main hallway (new)	0.00	no
A-55	wood	chair rail	cream	1st floor main hallway (new)	0.01	no
A-56	drywall	wall	pink	superior civil court #2	0.00	no
A-57	wood	door frame	cream	superior civil court #2	0.00	no
A-58	drywall	wall	light blue	juvenile waiting area	0.00	no
A-59	metal	door	purple	holding cell	0.01	no
A-60	concrete	wall	cream	old court 2nd floor	0.00	no
A-61	wood	door frame	tan	old court 2nd floor	0.20	no
A-62	wood	door	tan	old court 2nd floor	0.00	no
A-63	plaster	wall a	white	community service 2nd floor	0.00	no
A-64	metal	door	blue	south end 3rd floor	0.00	no
A-65	wood	door	blue	south end 3rd floor	0.10	no
A-66	wood	door	light tan	district attorney west wing	0.20	no
A-67	plaster	wall b	tan	4th floor jail file room	0.10	no
A-68	drywall	wall a	white	4th floor jail file room	0.11	no
A-69	wood	door frame	blue	4th floor jail file room	0.10	no
A-70	wood	baseboard	black	hallway in front of file room	0.10	no
A-71	drywall	wall	light blue	storage area 4th floor	0.04	no
A-72	wood	door frame	brown	storage area 4th floor	0.01	no
A-73	ceramic	tile	gray	hallway of attorney office 4th floor	3.50	yes
A-74	metal	wall	blue	hallway of attorney office 4th floor	0.15	no
A-75	plaster	wall	light green	kitchen closet (top jail)	0.10	no
A-76	metal	bars	white	4th floor north staircase	0.60	no
A-77	metal	window sill	white	4th floor north staircase	0.23	no
A-78	metal	window frame	brown	main lobby -1	0.00	no
A-79	metal	pole	brown	main lobby -1	0.00	no
A-80	drywall	wall	white	main lobby -1	0.00	no
A-81	wood	door frame	pink	main lobby -1	0.00	no
A-82	drywall	wall	yellow	main lobby -1	0.00	no
A-83	metal	stairs	brown	main lobby -1	0.00	no
A-84	metal	border	black	main lobby -1	0.00	no
A-85	metal	window frame	brown	main lobby -1	1.50	yes
A-86	metal	window frame	brown	main lobby close to south end	1.30	yes
A-87		SRM - 2579	Red	Calibration Test	1.10	NA
A-88		SRM - 2579	Red	Calibration Test	1.10	NA
A-89		SRM - 2579	Red	Calibration Test	1.00	NA



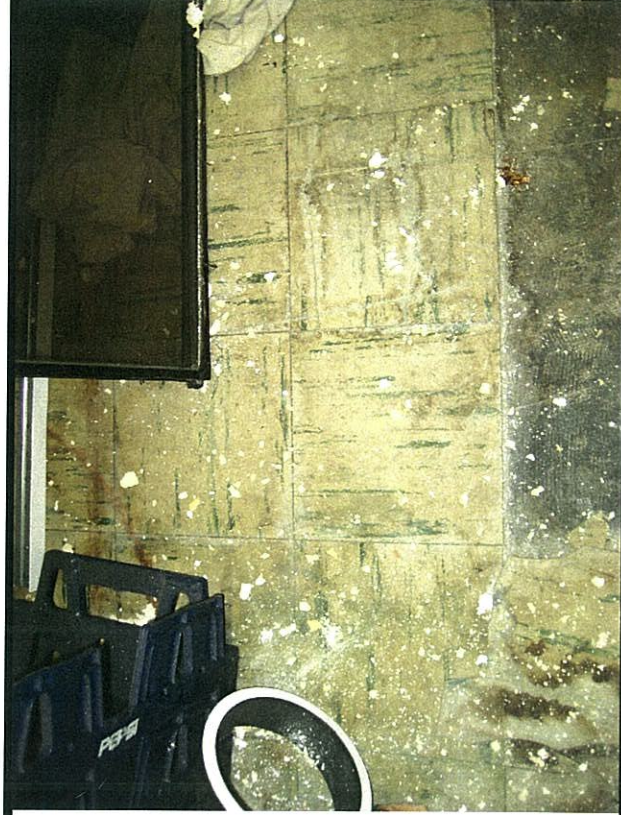
Metal Window Frames Painted Brown (LBP) and Glazing (ACM) in Main Lobby.



Pipe Insulation on pipes in crawlspace



Boiler insulation located in Boiler Room



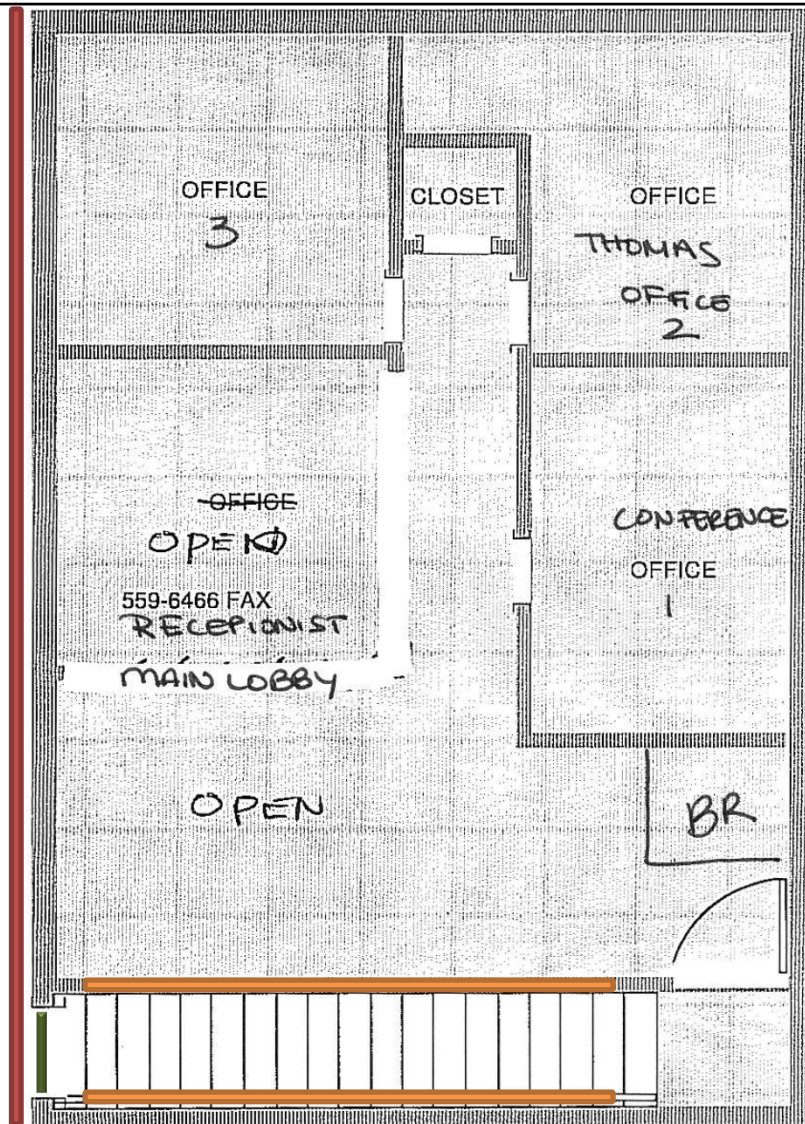
9" Floor Tiles and associated black mastic

**(B) COUNTY MANAGER**

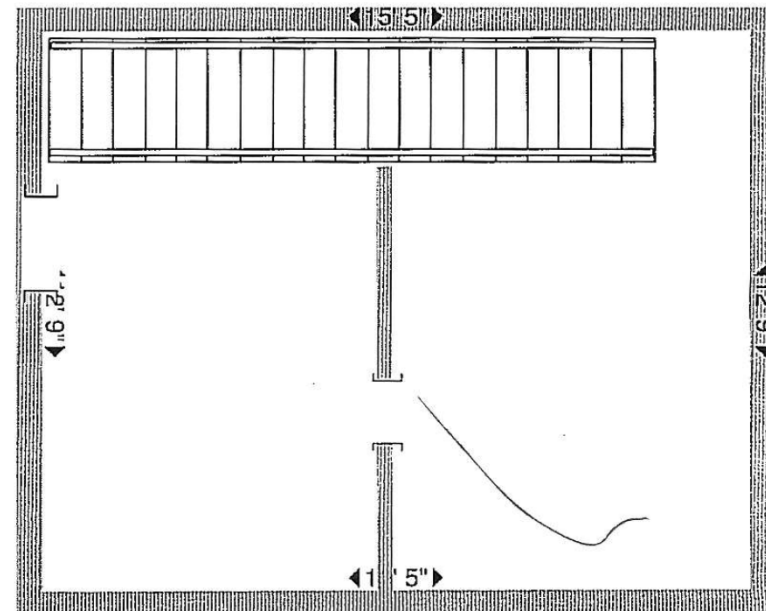


AND A FIRE STATION MUSEUM

UPSTAIRS



GROUND FLOOR



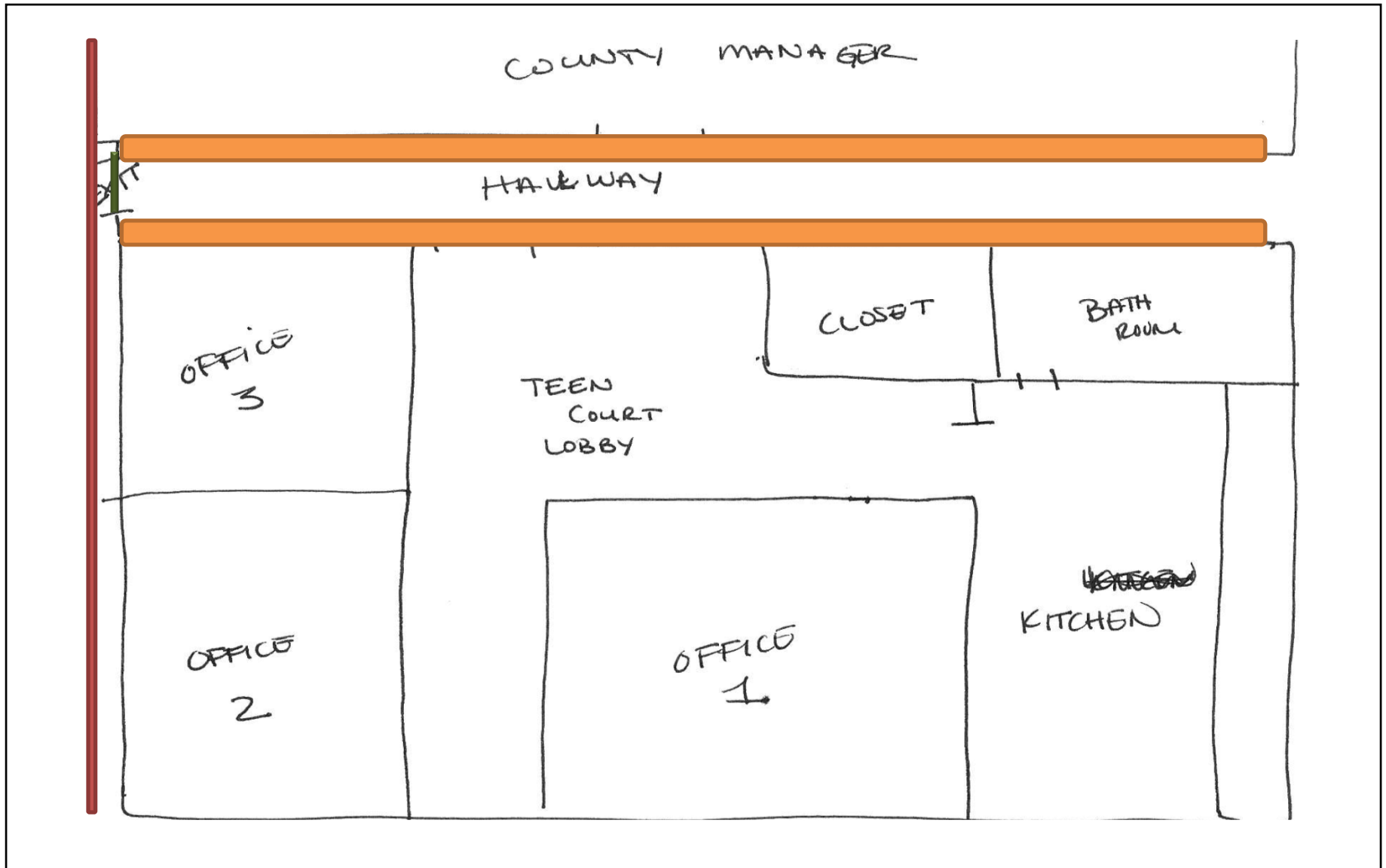
County Manager 2<sup>nd</sup> Floor

Prepared by  
KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

Notes:

- Cream lead based paint on walls
  - Red Lead-based containing paint on exterior walls
  - Green lead-based paint on exterior doors
- Floor Plan to be used for purpose of this report only

Prepared for  
County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502



**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

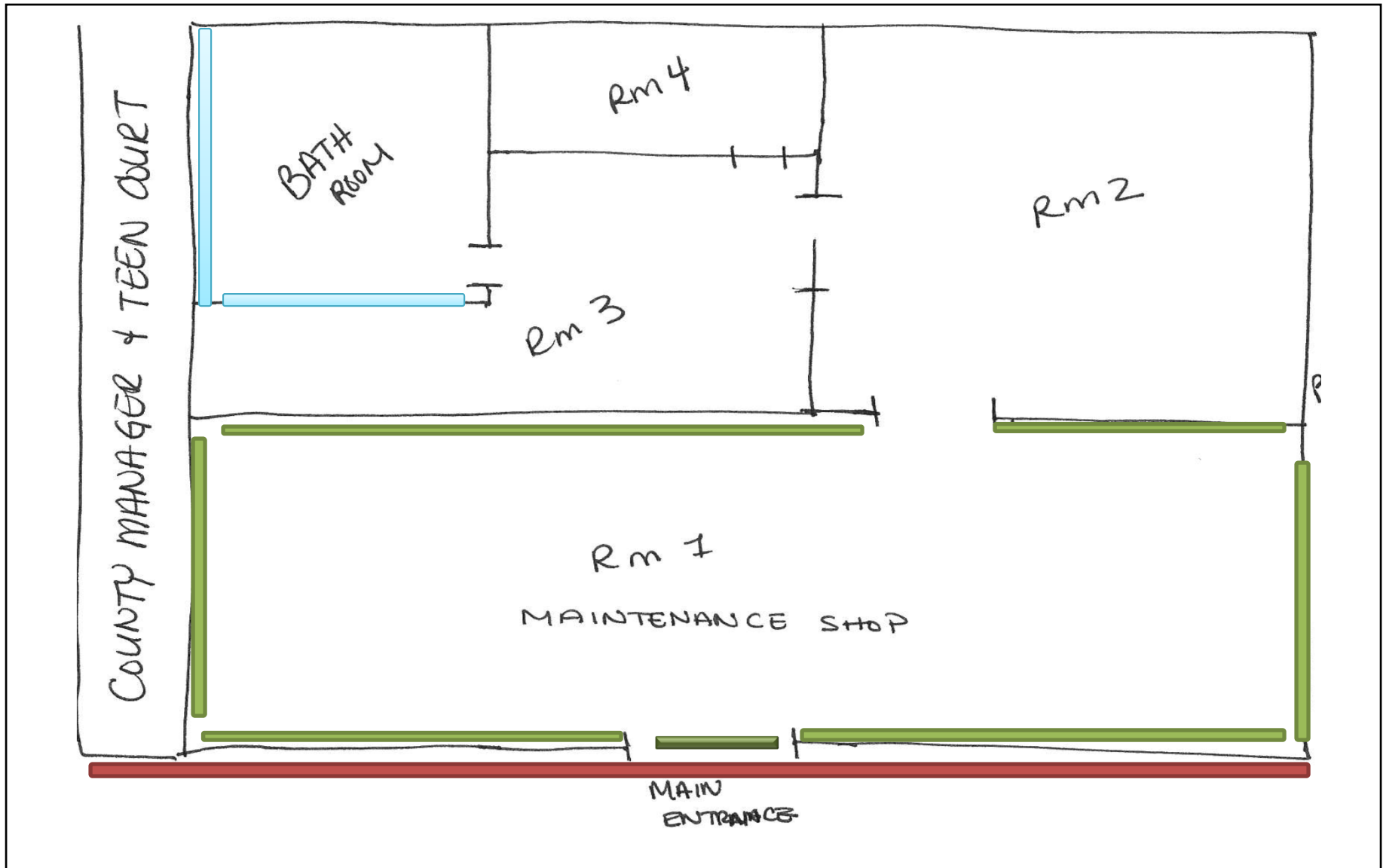
**Teen Court**

Notes:

- Cream lead-based paint on walls
- Red lead-based containing paint on exterior walls
- Green lead-based paint on exterior doors

Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



Prepared by  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

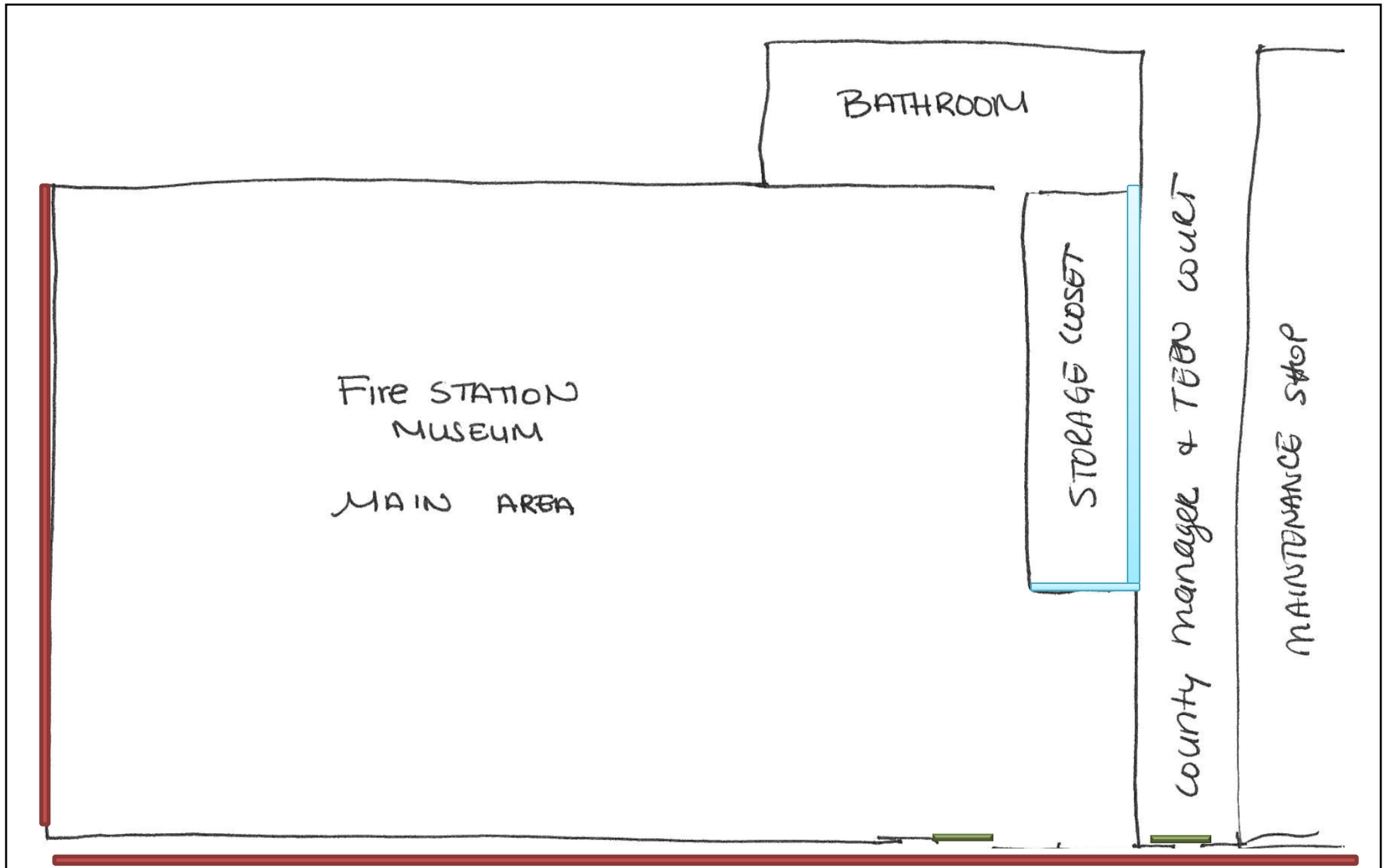
**Maintenance Shop**

Notes:

- Light green lead-based paint on walls
- Red lead-based containing paint on exterior walls
- White lead-based paint on walls
- Green lead-based paint on exterior doors

Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



Prepared by  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Fire Station Museum**

Notes:

- Red lead-based containing paint on exterior walls
- White lead-based paint on walls
- Green lead-based paint on exterior doors

Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200501  
 Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone <input type="checkbox"/> : 410.891.1726
4601 Six Forks Rd., 220	Fax <input type="checkbox"/> : 410316.7935
Raleigh, NC 27609	Email <input type="checkbox"/> : tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number:
Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 10 sets.			
set B	Sample # B-1 to B-23		- Please apply positive stop as indicated on sampling datasheets.
Set C	Sample # C-1 to C-30		
Set D	Sample # D-1 to D-6		
Set E	Sample # E-1 to E-42		- Please separate layers for Floor Tile and Mastic & Plaster samples.
Set F	Sample # F-1 to F-32		
Set G	Sample # G-1 to G-36		
Set H	Sample # H-1 to H-48		
Set I	Sample # I-1 to I-11		- Please provide separate reports for each set of samples.
Set J	Sample # J-1 to J-31		
Set K	Sample # K-1 to K-42.		

Total # of Samples

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/11/2012		1-12 9:30A

Accepted   
 Rejected

Page \_\_\_ of \_\_\_



1200501



## ASBESTOS BULK SAMPLE SHEET

Job Order No: 15111236

Location:

County Managers Office

Date: 1/9/2012

Inspector: Tehsin Aurangabadwala

Signature: \_\_\_\_\_

Page: 1. of 2

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
B-1	Drywall / Joint Compound	Firestation Museum		G.	} Positive Stop.	
B-2	Drywall / Joint Compound	Firestation Museum		G		
B-3	Linoleum Flooring	Firestation Museum Bathroom		G	} Positive Stop.	
B-4	Linoleum Flooring	Firestation Museum Bathroom.		G		
B-5	Linoleum Flooring	Maintenance Shop Bathroom		G	} Positive Stop.	
B-6	Linoleum Flooring	Maintenance Shop Bathroom		G		
B-7	Plaster - skim	Maintenance Shop Bathroom		Damage.	} Positive Stop for all skim and all base.	
B-8	Plaster - base	" " "		↓		
B-9	Plaster - skim	" " "		↓		
B-10	Plaster - base	" " "		↓		
B-11	Plaster - skim	Maintenance Shop Entrance office		Damage	} Positive Stop.	
B-12	Plaster - base	" " " "		Damage		
B-13	Plaster - popcorn	Teen Court. Asst. Dist Attorney - lobby - Ceiling		G	} Positive Stop.	
B-14	Plaster - popcorn	" " " " " - Kitchen - Ceiling		G		
B-15	Plaster - popcorn	" " " " " - Rest Room - Ceiling		G		
B-16	Drywall / Joint Compound	Teen Court - Kitchen		G	} Positive Stop.	
B-17	Drywall / Joint Compound	Teen Court - Storage Rm.		G		
B-18	Linoleum Flooring	Teen Court - Rest Room.		G	- Positive Stop with B19	





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200501

**Analysis ID:** 1200501PLM

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set B County  
Managers Office

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
B-1	Drywall/joint compound	None Detected	8% Cellulose	92% Other	Brown Fibrous Heterogeneous
1200501PLM_1	<i>drywall only</i>				Teased
B-2	Drywall/joint compound	None Detected	15% Cellulose	85% Other	White, Brown Fibrous Heterogeneous
1200501PLM_2	<i>drywall: none detect; joint compnd: none detect</i>				Teased
B-3	Linoleum flooring	None Detected	15% Cellulose 5% Synthetic Fibers	80% Other	Gray Fibrous Heterogeneous
1200501PLM_3					Teased
B-4	Linoleum flooring	None Detected	15% Cellulose 5% Synthetic Fibers	80% Other	Gray Fibrous Heterogeneous
1200501PLM_4					Teased
B-5	Linoleum flooring	None Detected	5% Fiber Glass	95% Other	Tan Fibrous Heterogeneous
1200501PLM_5					Dissolved
B-6	Linoleum flooring	None Detected	5% Fiber Glass	95% Other	Tan Fibrous Heterogeneous
1200501PLM_6					Dissolved
B-7	Plaster-skim	None Detected		100% Other	White Non Fibrous Heterogeneous
1200501PLM_7					Crushed
B-8	Plaster-base	None Detected		90% Other 10% Quartz	Brown Non Fibrous Heterogeneous
1200501PLM_8					Crushed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Ired Gulley (25)

Analyst

Nathaniel Durham, MS or Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200501

**Analysis ID:** 1200501PLM

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set B County  
Managers Office

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
B-9	Plaster-skim	None Detected		100% Other	White Non Fibrous Heterogeneous
1200501PLM_9					Crushed
B-10	Plaster-base	None Detected		80% Other 20% Quartz	Brown Non Fibrous Heterogeneous
1200501PLM_10					Crushed
B-11	Plaster-skim	None Detected		100% Other	White Non Fibrous Heterogeneous
1200501PLM_11					Crushed
B-12	Plaster-base	None Detected		80% Other 20% Quartz	Brown Non Fibrous Heterogeneous
1200501PLM_12					Crushed
B-13	Plaster-popcorn	None Detected	3% Cellulose	97% Other	White Non Fibrous Heterogeneous
1200501PLM_13					Teased
B-14	Plaster-popcorn	None Detected	3% Cellulose	97% Other	White Non Fibrous Heterogeneous
1200501PLM_14					Teased
B-15	Plaster-popcorn	None Detected	3% Cellulose	97% Other	White Non Fibrous Heterogeneous
1200501PLM_15					Teased
B-16	Drywall/joint compound	None Detected	15% Cellulose	85% Other	White, Brown Fibrous Heterogeneous
1200501PLM_16	<i>drywall: none detect; joint compnd: none detect</i>				Teased

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Ired Gulley (25)

Analyst

Nathaniel Durham, MS or Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200501

**Analysis ID:** 1200501PLM

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set B County  
Managers Office

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
B-17	Drywall/joint compound	None Detected	15% Cellulose	85% Other	White, Brown Fibrous Heterogeneous
1200501PLM_17	<i>drywall: none detect; joint compnd: none detect</i>				Teased
B-18 - A	Linoleum flooring	None Detected	15% Cellulose 5% Synthetic Fibers	80% Other	White Fibrous Heterogeneous
1200501PLM_18	<i>linoleum</i>				Teased
B-18 - B	Linoleum flooring	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Heterogeneous
1200501PLM_24	<i>mastic</i>				Dissolved
B-19 - A	Linoleum flooring	None Detected	15% Cellulose 5% Synthetic Fibers	80% Other	White Fibrous Heterogeneous
1200501PLM_19	<i>linoleum</i>				Teased
B-19 - B	Linoleum flooring	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Heterogeneous
1200501PLM_25	<i>mastic</i>				Dissolved
B-20	Plaster-popcorn	None Detected		100% Other	White Non Fibrous Heterogeneous
1200501PLM_20					Teased
B-21	Plaster-popcorn	None Detected		100% Other	White Non Fibrous Heterogeneous
1200501PLM_21					Teased
B-22	Ceiling tile - 2x2	None Detected	40% Cellulose 40% Fiber Glass	10% Perlite 10% Other	White Fibrous Heterogeneous
1200501PLM_22					Teased

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Ired Gulley (25)

Analyst

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888

Nathaniel Durham, MS or Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200501

**Analysis ID:** 1200501PLM

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set B County  
Managers Office

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
B-23	Ceiling tile - 2x2	None Detected	40% Cellulose 40% Fiber Glass	10% Perlite 10% Other	White Fibrous Heterogeneous
1200501PLM_23			Teased		

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Ired Gulley (25)

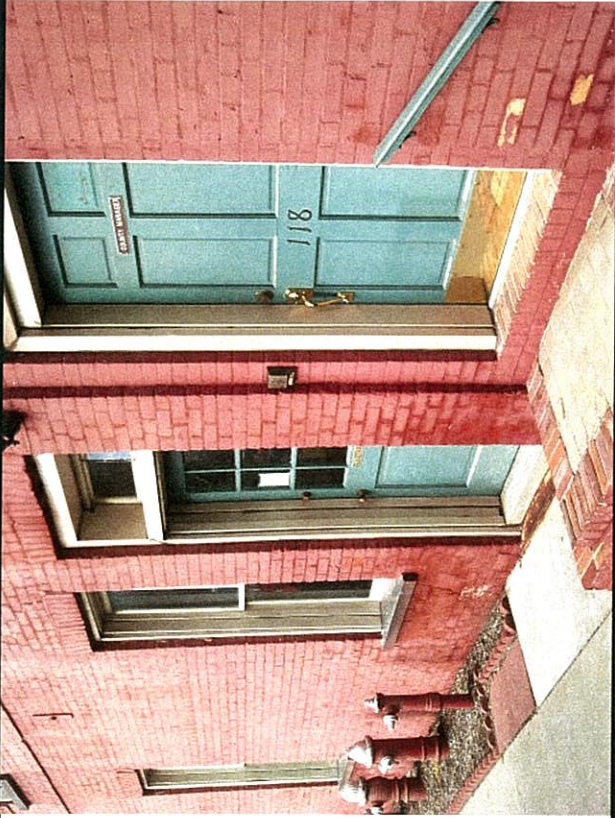
Analyst

Nathaniel Durham, MS or Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.20	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA
B-1	wood	window frame	green	facing queen st	0.50	no
B-2	wood	door	green	facing queen st	0.50	no
B-3	drywall	wall a	white	facing the court	0.00	no
B-4	drywall	wall c	white	closet to bathroom	0.00	no
B-5	metal	pole	green	middle of firestation museum	0.06	no
B-8	wood	window	white	near entrance	0.00	no
B-9	wood	window sill	green	near entrance	0.30	no
B-10	wood	baseboard	green	near entrance beneath window	0.00	no
B-11	wood	door frame	green	bathroom	0.50	no
B-12	brick	wall d	white	closet	5.70	yes
B-13	wood	wall a	white	closet	1.60	yes
B-14	wood	door	white	closet	0.09	no
B-15	wood	door	green	exterior of firestation	0.07	no
B-16	metal	door frame	cream	exterior of firestation	0.07	no
B-17	brick	wall a	red	exterior of county manager	0.50	no
B-18	plaster	wall a	light green	main entrance of maintenance shop	0.80	yes
B-19	plaster	wall d	light green	main entrance of maintenance shop	0.00	no
B-20	plaster	wall c	light green	facing room 2 of maintenance shop	0.80	yes
B-21	wood	door	white	main entrance of maintenance shop	0.60	no
B-22	wood	door frame	white	main entrance of maintenance shop	0.21	no
B-23	metal	door	white	room 2 of maintenance shop	0.00	no
B-24	drywall	wall c	light green	room 3 of maintenance shop	0.50	no
B-25	drywall	wall d	white	room 4	0.60	no
B-27	brick	wall b	white	bathroom of maintenance shop	2.10	yes
B-28	plaster	wall a	white	bathroom of maintenance shop	0.80	yes
B-29	wood	door	white	bathroom of maintenance shop	0.01	no
B-30	wood	door	green	exterior of main entrance	1.70	yes
B-31	brick	wall	red	exterior of main entrance	3.50	yes
B-32	wood	door	green	main entrance of teen court	0.00	no
B-33	wood	door frame	tan	main entrance of teen court	0.00	no
B-35	drywall	wall a	wall paper	main entrance of teen court	0.01	no
B-36	wood	door	tan	office 3 of teen court	0.00	no
B-37	drywall	wall a	wall paper	office 1 of teen court	0.00	no
B-38	wood	window frame	cream	office 1 of teen court	0.00	no
B-39	plaster	ceiling	white	teen court lobby	0.01	no
B-40	drywall	wall a	wall paper	teen court bathroom	0.00	no
B-41	brick	wall d	cream	hallway between teen court and cou	3.40	yes
B-42	drywall	wall c	cream	hallway between teen court and cou	0.00	no
B-43	wood	railing	green	hallway between teen court and cou	0.00	no
B-44	wood	door frame	cream	hallway between teen court and cou	3.60	yes
B-45	wood	door	green	hallway between teen court and cou	0.00	no
B-46	drywall	wall d	light gray	main entrance county manager offic	0.00	no
B-47	metal	door frame	white	main entrance county manager offic	0.00	no
B-48	wood	door frame	white	main entrance county manager offic	0.00	no
B-49	drywall	wall a	wall paper	county manager bathroom	0.00	no
B-50	plaster	ceiling	white	county manager bathroom	0.00	no
B-51	wood	window frame	white	office 1 county manager	0.00	no
B-52	drywall	wall a	white	closet county manager	0.00	no
B-53	drywall	wall c	light gray	office 2 county manager	0.00	no
Cal4		SRM - 2579	Red	Calibration Test	1.10	NA
Cal5		SRM - 2579	Red	Calibration Test	1.10	NA
Cal6		SRM - 2579	Red	Calibration Test	1.00	NA





Exterior Brick Walls Painted Red



Wooden Doors Painted Green in front of Maintenance Shop



Brick Walls Painted White between County Manager and Teen Court Office

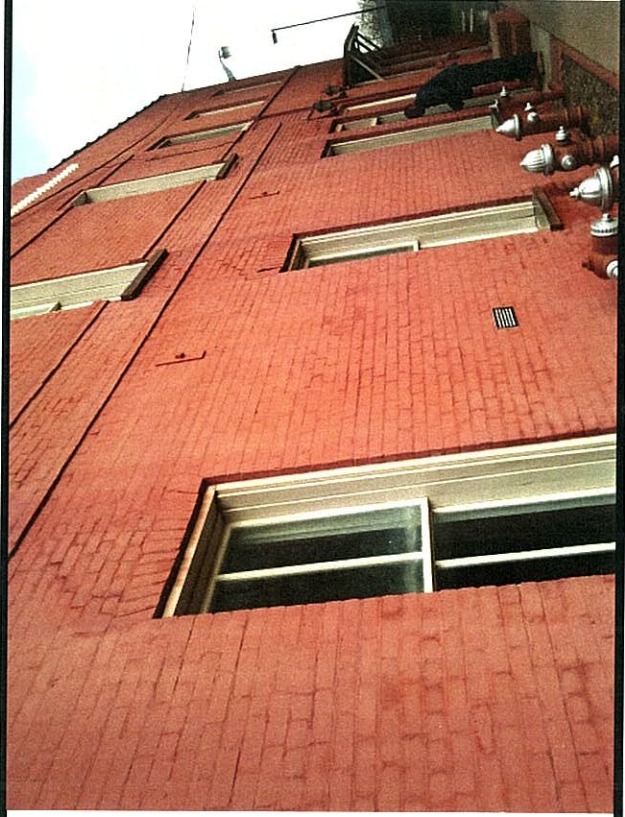


Brick Wall Painted White in Fire Station Museum Closet





Plaster Walls Painted Light Green in Maintenance Shop



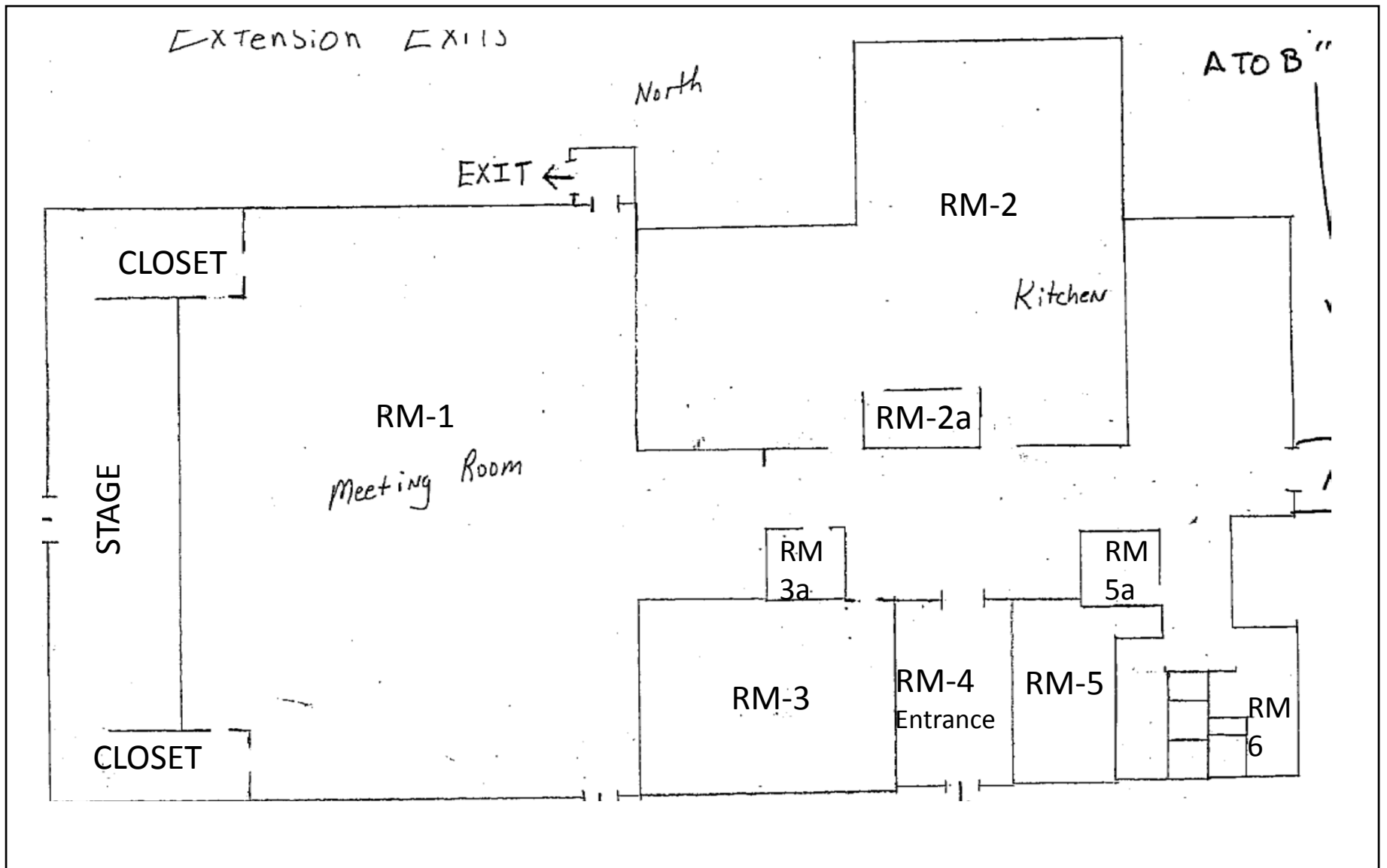
Brick Walls Painted White in Maintenance Shop Bathroom



Wooden Walls Painted White inside Fire Station Museum Closet



**(C) COOPERATIVE EXTENSION**

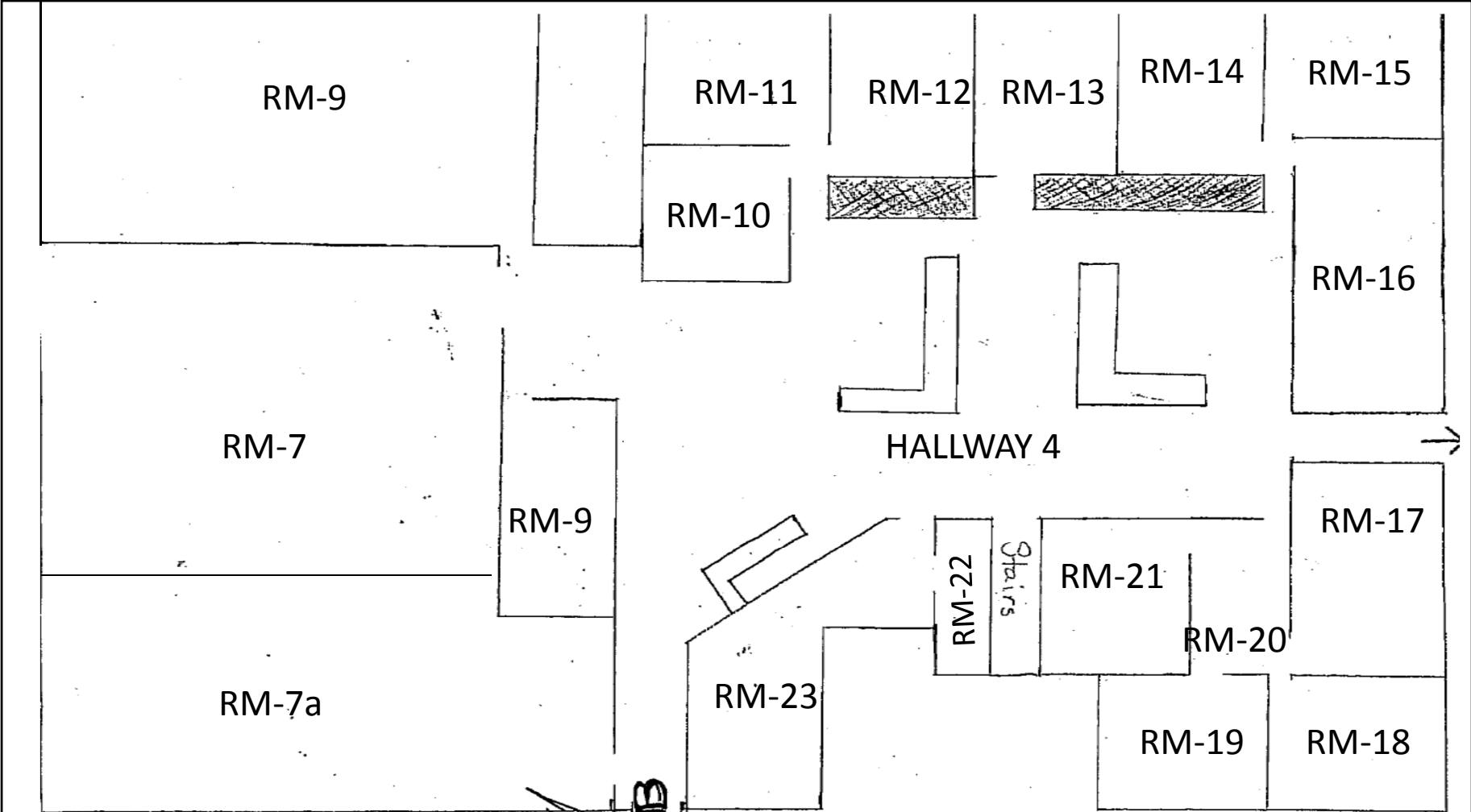


Prepared by  
 KCI Associates of North Carolina, P.A.  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

Cooperative Extension 1<sup>st</sup> Floor Part One

Notes:  
 Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



Prepared by  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

Cooperative Extension 1<sup>st</sup> Floor Part Two  
 Notes:  
 Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502

STAIRS

2<sup>nd</sup> Floor Storage Area

**Prepared by**

KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

**Cooperative Extension 2<sup>nd</sup> Floor**

Notes:  
Floor Plan to be used for purpose of this report only

**Prepared for**

County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502





**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200510

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone ☐: 410.891.1726
4601 Six Forks Rd., 220	Fax ☐: 410316.7935
Raleigh, NC 27609	Email ☐: tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number: \_\_\_\_\_  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 10 sets.			
set B	Sample # B-1 to B-23	-	Please apply positive stop as indicated on sampling datasheets.
Set C	Sample # C-1 to C-30		
Set D	Sample # D-1 to D-6		
Set E	Sample # E-1 to E-42		Please separate layers for Floor Tile and Mastic & Plaster samples.
Set F	Sample # F-1 to F-32	-	
Set G	Sample # G-1 to G-36		
Set H	Sample # H-1 to H-48		Please provide separate reports for each set of samples.
Set I	Sample # I-1 to I-11		
Set J	Sample # J-1 to J-31	-	
Set K	Sample # K-1 to K-42		

Total # of Samples \_\_\_\_\_

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/11/2012		1-12 2:30A

Accepted   
 Rejected

1200510



## ASBESTOS BULK SAMPLE SHEET

Job Order No: 15111236

Location:

Lenoir County Cooperative Extension (C)

Date: 1-11-12

Inspector: WILLIAM S. LANE

Signature: *William S. Lane*

Page: 1 of 2

Sample No	Type of Material	Location / Description	Friable		Quantity	Remarks
			Yes / No / Potential	Condition Good/ Damaged		
C-01	Carpet mastic					] Positive Stop.
C-02	" "					
C-03	concrete base/mastic (grey)					
C-04	" " " "					
C-05	FT / mastic	Back Door Area Between Rm 17 & 16			36 SF	] PS. Separate layers
C-06	" "	" " " "				
C-07	FT / mastic	Rm 7a			338 SF	] PS. Separate layers.
C-08	" "	" "				
C-09	SR / JC	Rm 22				] PS - one composite sample.
C-10	" "	" "				
C-11	pipe insulation paper	fiberglass wrap in 5a				] PS.
C-12	" "	" " " "				
C-13	FT / mastic (grey)	5a, Hall 3 Homogenous			4827 SF	] PS - Separate layers.
C-14	" "	" "				
C-15	spray on ceiling	throughout building				] PS
C-16						
C-17						
C-18						

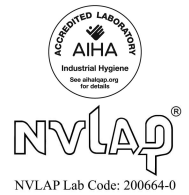






# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200510

**Analysis ID:** 1200510\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/18/2012

**Project:** 15111236 IHG-00 Set C Lenoir County  
Cooperative Extension

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
C-1	Carpet mastic	None Detected	3% Synthetic Fibers	97% Other	Yellow Non Fibrous Homogeneous
1200510PLM_1					Dissolved
C-2	Carpet mastic	None Detected	3% Synthetic Fibers	97% Other	Yellow Non Fibrous Homogeneous
1200510PLM_2					Dissolved
C-3 - A	Cove base / mastic (grey)	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200510PLM_3	cove base				Ashed
C-3 - B	Cove base / mastic (grey)	None Detected		100% Other	Cream Non Fibrous Homogeneous
1200510PLM_31	mastic				Dissolved
C-4 - A	Cove base / mastic (grey)	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200510PLM_4	cove base				Ashed
C-4 - B	Cove base / mastic (grey)	None Detected		100% Other	Cream Non Fibrous Homogeneous
1200510PLM_32	mastic				Dissolved
C-5 - A	FT/mastic	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200510PLM_5	tile				Dissolved
C-5 - B	FT/mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200510PLM_33	mastic				Dissolved

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Sharon Donald (36)

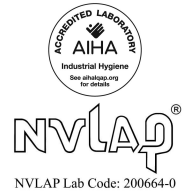
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200510

**Analysis ID:** 1200510\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/18/2012

**Project:** 15111236 IHG-00 Set C Lenoir County  
Cooperative Extension

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
C-6 - A	FT/mastic	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200510PLM_6	tile				Dissolved
C-6 - B	FT/mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200510PLM_34	mastic				Dissolved
C-7	FT/mastic	None Detected		100% Other	Gray, White Non Fibrous Heterogeneous
1200510PLM_7	tile only				Dissolved
C-8	FT/mastic	None Detected		100% Other	Gray, White Non Fibrous Heterogeneous
1200510PLM_8	tile only				Dissolved
C-9	SR/JC	None Detected	15% Cellulose	55% Gypsum 30% Other	Brown, White Fibrous Heterogeneous
1200510PLM_9	sheetrock: none detect; joint compnd: none detect				Crushed
C-10	SR/JC	None Detected	15% Cellulose	55% Gypsum 30% Other	Brown, White Fibrous Heterogeneous
1200510PLM_10	sheetrock: none detect; joint compnd: none detect				Crushed
C-11	Pipe insulation paper	None Detected	70% Cellulose 10% Fiber Glass	20% Other	Gray, Tan, Silver Fibrous Heterogeneous
1200510PLM_11					Teased, Dissolved
C-12	Pipe insulation paper	None Detected	70% Cellulose 10% Fiber Glass	20% Other	Gray, Tan, Silver Fibrous Heterogeneous
1200510PLM_12					Teased, Dissolved

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Sharon Donald (36)

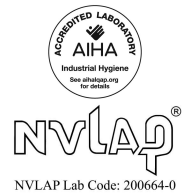
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200510

**Analysis ID:** 1200510\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/18/2012

**Project:** 15111236 IHG-00 Set C Lenoir County  
Cooperative Extension

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
C-13 - A	FT/mastic (grey)	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200510PLM_13	tile				Dissolved
C-13 - B	FT/mastic (grey)	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200510PLM_35	mastic				Dissolved
C-14 - A	FT/mastic (grey)	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200510PLM_14	tile				Dissolved
C-14 - B	FT/mastic (grey)	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200510PLM_36	mastic				Dissolved
C-15	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200510PLM_15					Teased
C-16	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200510PLM_16					Teased
C-17	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200510PLM_17					Teased
C-18	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200510PLM_18					Teased

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Sharon Donald (36)

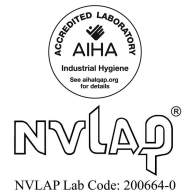
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200510

**Analysis ID:** 1200510\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/18/2012

**Project:** 15111236 IHG-00 Set C Lenoir County  
Cooperative Extension

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
C-19	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200510PLM_19					Teased
C-20	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200510PLM_20					Teased
C-21	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200510PLM_21					Teased
C-22	Spray-on ceiling repair	None Detected		100% Other	White Non Fibrous Heterogeneous
1200510PLM_22					Teased
C-23	2x4 ceiling tile	None Detected	50% Cellulose 30% Mineral Wool	10% Perlite 10% Other	Gray, White Fibrous Heterogeneous
1200510PLM_23					Teased
C-24	2x4 ceiling tile	None Detected	50% Cellulose 30% Mineral Wool	10% Perlite 10% Other	Gray, White Fibrous Heterogeneous
1200510PLM_24					Teased
C-25	2x2 ceiling tile	None Detected	50% Cellulose 30% Mineral Wool	10% Perlite 10% Other	Gray, White Fibrous Heterogeneous
1200510PLM_25					Teased
C-26	2x2 ceiling tile	None Detected	50% Cellulose 30% Mineral Wool	10% Perlite 10% Other	Gray, White Fibrous Heterogeneous
1200510PLM_26					Teased

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Sharon Donald (36)

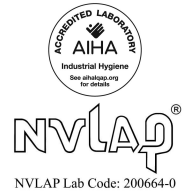
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200510

**Analysis ID:** 1200510\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/18/2012

**Project:** 15111236 IHG-00 Set C Lenoir County  
Cooperative Extension

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
C-27	Caulking	None Detected		100% Other	Brown Non Fibrous Homogeneous
1200510PLM_27					Ashed
C-28	Caulking	None Detected		100% Other	Brown Non Fibrous Homogeneous
1200510PLM_28					Ashed
C-29	Caulking	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200510PLM_29					Ashed
C-30	Caulking	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200510PLM_30					Ashed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Sharon Donald (36)

Analyst

Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA
C-1	metal	door frame	gray	room 7	0.00	no
C-2	drywall	wall c	gray dots	room 8	0.00	no
C-3	metal	door frame	gray	room 22	0.00	no
C-4	drywall	wall a	white	stairs close to room 22	0.00	no
C-5	drywall	wall c	gray dots	room 16	0.00	no
C-6	drywall	wall b	light gray	room 7a	0.00	no
C-7	metal	pipng	white	room 7a	0.01	no
C-8	drywall	wall d	light blue	room 6	0.00	no
C-9	drywall	wall a	tan	room 4 foyer	0.00	no
C-10	plaster	ceiling	white	hallway 2	0.00	no
C-11	metal	door	gray	room 1 auditorium	0.00	no
C-12	drywall	wall	tan dot	room 1 auditorium	0.00	no
Cal4		SRM - 2579	Red	Calibration Test	1.20	NA
Cal5		SRM - 2579	Red	Calibration Test	1.00	NA
Cal6		SRM - 2579	Red	Calibration Test	1.10	NA





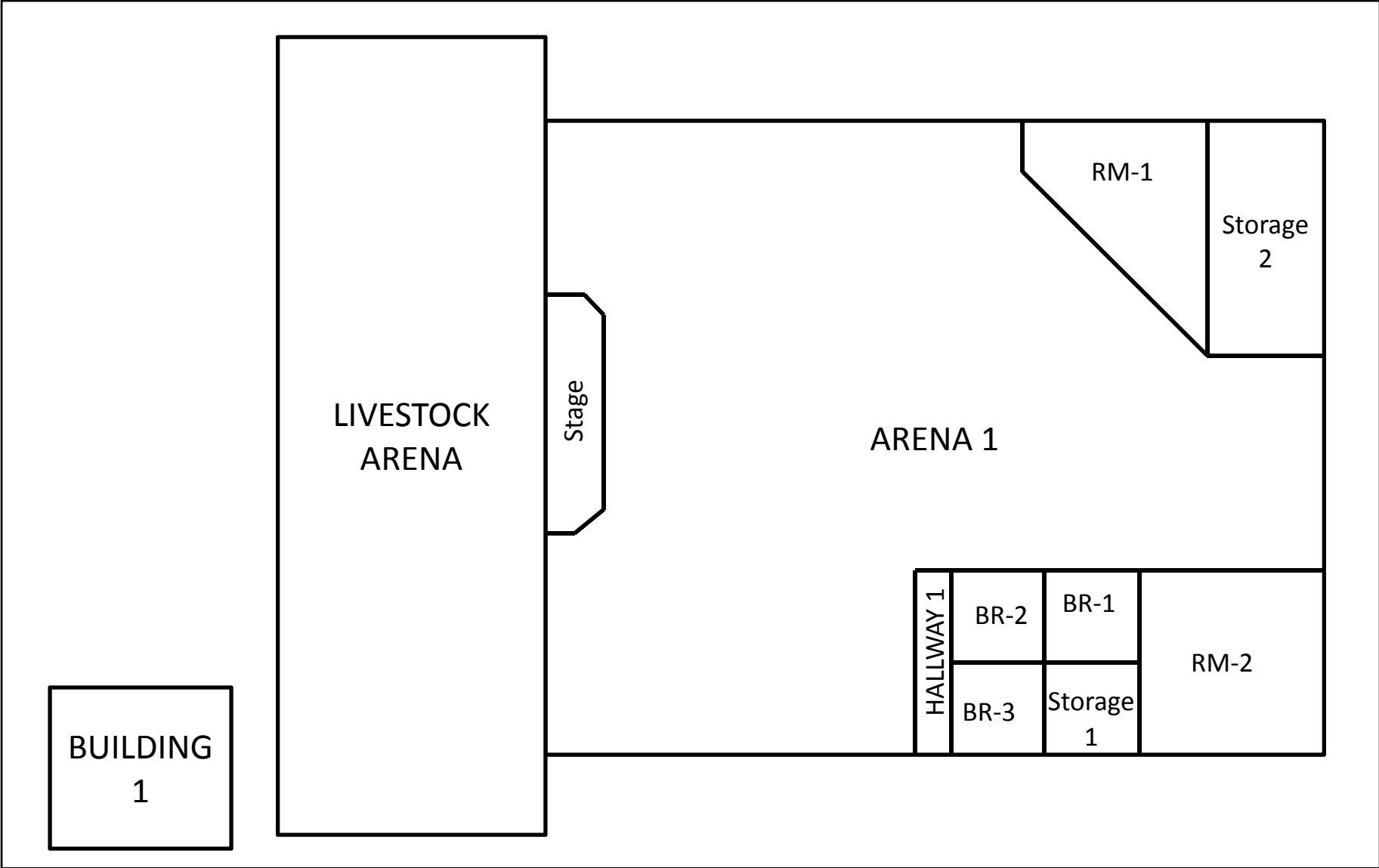
Lenoir County Cooperative Extension Building (Front)



Lenoir County Cooperative Extension Building (Rear)

**(D) LIVESTOCK ARENA**





**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Front Livestock Arena**  
 Notes:  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502

LIVESTOCK ARENA

Arena 1

**Prepared by**  
KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

**Back Livestock Arena**  
Notes:  
Floor Plan to be used for purpose of this report only

**Prepared for**  
County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200509

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone: 410.891.1726
4601 Six Forks Rd., 220	Fax: 410316.7935
Raleigh, NC 27609	Email: tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number: \_\_\_\_\_  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 10 sets.			
set B	Sample # B-1 to B-23	- Please apply positive stop as indicated on sampling datasheets.	
set C	Sample # C-1 to C-30		
Set D	Sample # D-1 to D-6		
Set E	Sample # E-1 to E-42		
Set F	Sample # F-1 to F-32		
Set G	Sample # G-1 to G-36	- Please separate layers for Floor Tile and Mastic & Plaster samples.	
Set H	Sample # H-1 to H-48		
Set I	Sample # I-1 to I-11		
Set J	Sample # J-1 to J-31	- Please provide separate reports for each set of samples.	
Set K	Sample # K-1 to K-42.		

Total # of Samples

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/11/2012.		1-12 9:30A

Accepted   
 Rejected





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200509

**Analysis ID:** 1200509PLM

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set D Livestock  
Building

Sample ID	Description	Asbestos	Fibrous Components		Non-Fibrous Components		Attributes
Lab Sample ID	Lab Notes						Treatment
D-01	Ceiling tile	None Detected	60%	Cellulose	10%	Perlite	Tan, White Fibrous Heterogeneous
1200509PLM_1			20%	Fiber Glass	10%	Other	Crushed
D-02	Ceiling tile	None Detected	60%	Cellulose	10%	Perlite	Tan, White Fibrous Heterogeneous
1200509PLM_2			20%	Fiber Glass	10%	Other	Crushed
D-03	Carpet mastic	None Detected			100%	Other	Yellow Non Fibrous Heterogeneous
1200509PLM_3							Dissolved
D-04	Carpet mastic	None Detected			100%	Other	Yellow Non Fibrous Heterogeneous
1200509PLM_4							Dissolved
D-05 - A	FT/mastic	None Detected			100%	Other	White Non Fibrous Heterogeneous
1200509PLM_5	tile						Dissolved
D-05 - B	FT/mastic	None Detected	2%	Cellulose	98%	Other	Yellow Non Fibrous Heterogeneous
1200509PLM_7	mastic						Dissolved
D-06 - A	FT/mastic	None Detected			100%	Other	White Non Fibrous Heterogeneous
1200509PLM_6	tile						Dissolved
D-06 - B	FT/mastic	None Detected	3%	Cellulose	97%	Other	Yellow Non Fibrous Heterogeneous
1200509PLM_8	mastic						Dissolved

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Dorlos Ammerman (8)

Analyst

Nathaniel Durham, MS or Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA
D-1	metal	beam	green	main arena	0.22	no
D-2	metal	siding	green	main arena	0.25	no
D-3	metal	door	white	main arena	0.07	no
D-4	metal	door frame	white	main arena	0.00	no
D-5	wall insulation	wall d	white	main arena	0.00	no
D-6	metal	siding	green	main arena	0.05	no
D-7	concrete	floor	gray	main arena	0.01	no
D-8	metal	railing	black	main arena near back door	0.00	no
D-9	metal	door frame	brown	main arena back doors	0.30	no
D-10	metal	door frame	white	main arena back doors	0.00	no
D-11	metal	wall d	yellow	main arena	0.15	no
D-12	metal	wall a	yellow	main arena	0.09	no
D-13	metal	pole	green	back side of main arena	0.22	no
D-14	metal	bay doors	white	back side of main arena	0.01	no
D-15	metal	door	white	back side of main arena	0.01	no
D-16	metal	door frame	white	back side of main arena	0.00	no
D-17	metal	bay doors	white	exterior of main arena	0.01	no
D-18	metal	siding	yellow	exterior of main arena	0.10	no
D-19	metal	bay door frame	dark yellow	exterior of main arena	0.18	no
D-20	concrete	pole	brown	exterior of main arena	0.02	no
D-21	metal	door	white	exterior door in main entrance	0.01	no
D-22	metal	door frame	dark yellow	exterior door in main entrance	0.17	no
D-23	metal	siding	dark yellow	exterior facing cooperative extensio	0.22	no
D-24	brick	wall	brown	back of livestock arena	0.00	no
D-25	metal	bay doors	white	back of livestock arena	0.00	no
Cal4		SRM - 2579	Red	Calibration Test	0.90	NA
Cal5		SRM - 2579	Red	Calibration Test	1.00	NA
Cal6		SRM - 2579	Red	Calibration Test	1.00	NA



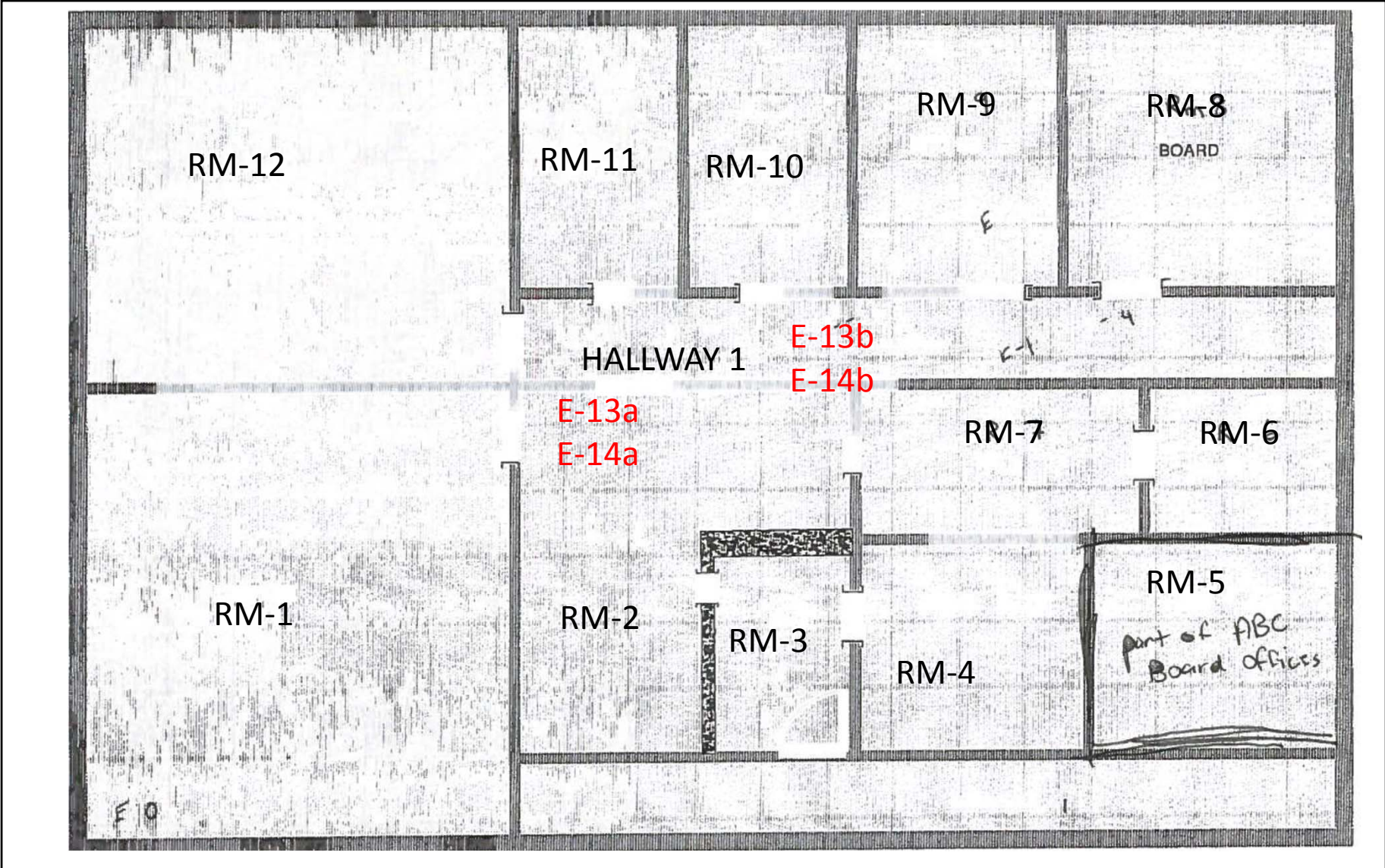
Livestock Arena . Assumed Asbestos Containing Roofing mastic and Sealants



Non Asbestos Floor tile in Room 1

**(E) ELECTIONS/ABC BUILDING**

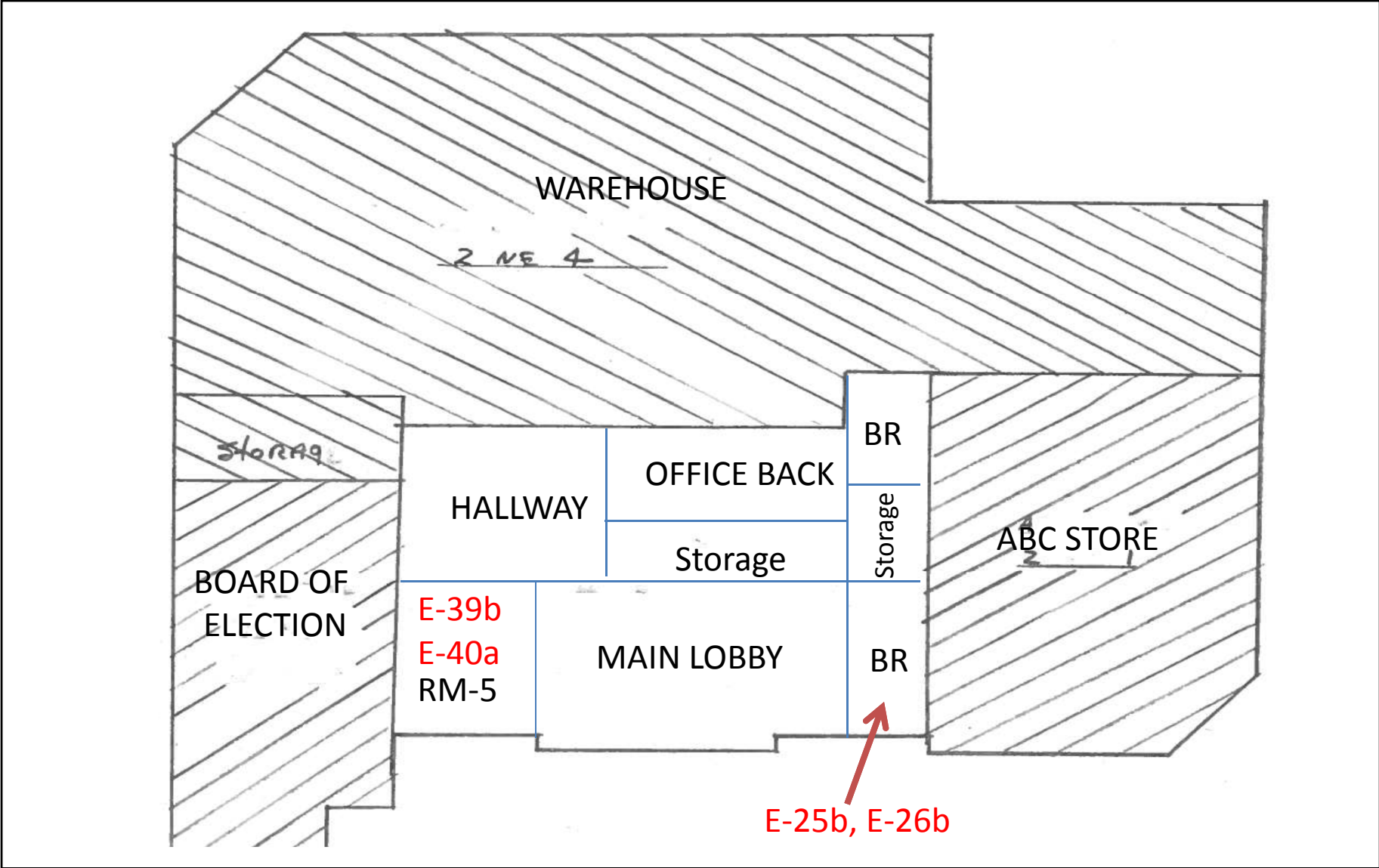




**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**ABC Board of Election**  
 Notes:  
 245 SF of asbestos-containing floor tile and mastic  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



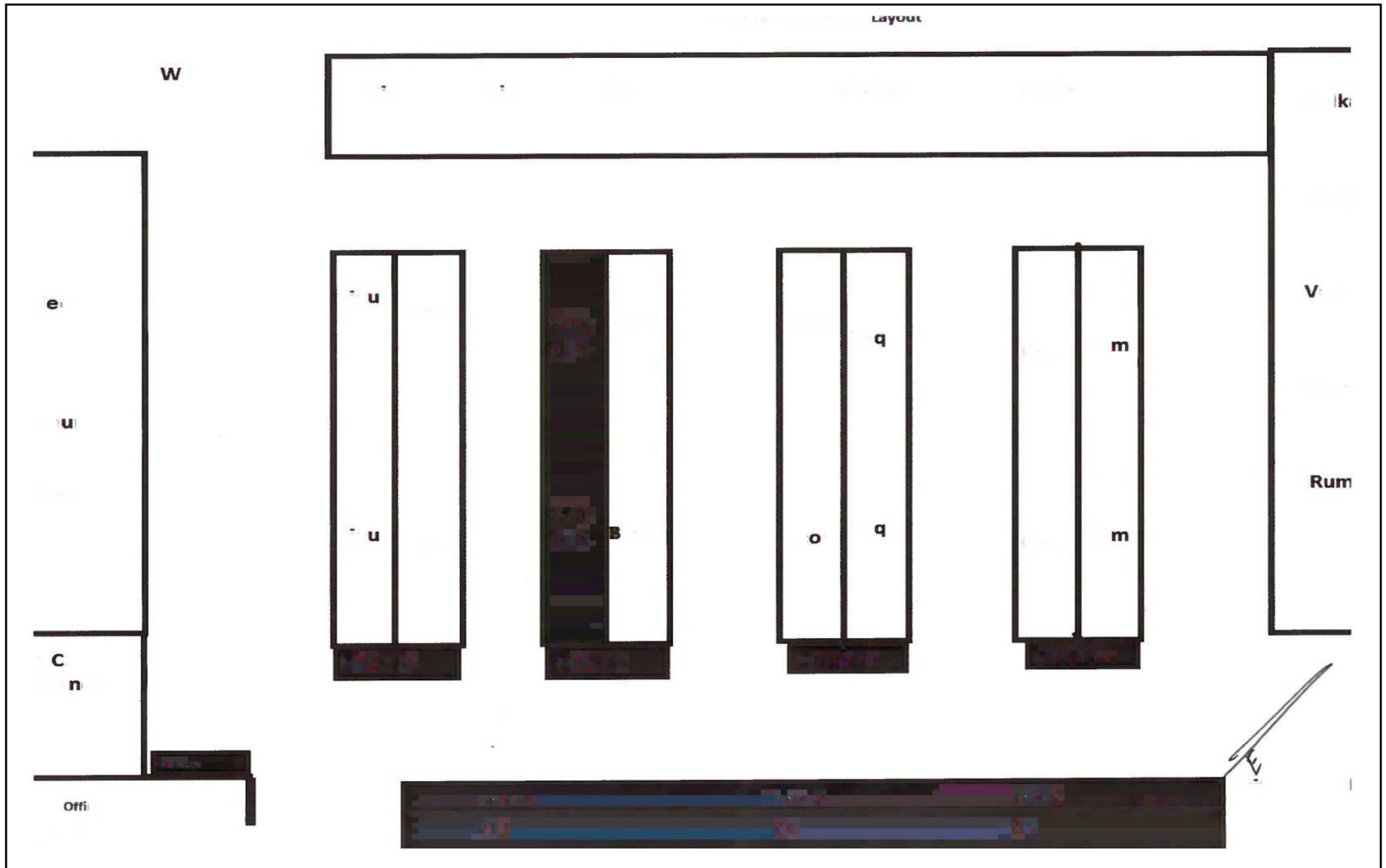
**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**ABC Offices**

Notes:  
 950 SF of asbestos-containing 12" floor tile and mastic  
 80 SF of asbestos-containing black floor tile mastic  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502

Layout



**Prepared by**  
KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

**ABC Store**  
Notes:  
Floor Plan to be used for purpose of this report only

**Prepared for**  
County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502





**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200495  
 Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone <input type="checkbox"/> : 410.891.1726
4601 Six Forks Rd., 220	Fax <input type="checkbox"/> : 410316.7935
Raleigh, NC 27609	Email <input type="checkbox"/> : tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHIERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number:
Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 10 sets.			
set B	Sample # B-1 to B-23		- Please apply positive stop as indicated on sampling datasheets.
set C	Sample # C-1 to C-30		
set D	Sample # D-1 to D-6		
set E	Sample # E-1 to E-42		
set F	Sample # F-1 to F-32		- Please separate layers for Floor Tile and Mastic & Plaster samples.
set G	Sample # G-1 to G-36		
set H	Sample # H-1 to H-48		
set I	Sample # I-1 to I-11		- Please provide separate reports for each set of samples.
set J	Sample # J-1 to J-31		
set K	Sample # K-1 to K-42.		

Total # of Samples

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/11/2012.		1-12 9:30A

Accepted   
 Rejected

1200495



ASBESTOS BULK SAMPLE SHEET

Job Order No: \_\_\_\_\_ Location: ABC / Board of Elections (E) Date: 1-10-12  
 Inspector: WILLIAM S. LANE Signature: William S. Lane Page: 1 of 3

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good / Damaged		
E-01	carpet mastic	Meeting Room (RM 1)				7 PS
E-02	" "	" "				7 PS
E-03	cove base / mastic	Meeting Room (RM 1)				7 PS Separate
E-04	" "	" "				7 PS Layers.
E-05	ceiling tile grey stucco	Meeting Room (RM 2)				7 PS
E-06	" 2x2 "	" "				7 PS
E-07	ceiling tile white	BOA Storage (RM 12)				7 PS
E-08	" 2x2 "	" "				7 PS
E-09	ceiling tile white	BOA Hall (Hall-1)				7 PS
E-10	" 2x2 "	" "				7 PS
E-11	carpet mastic	BOA Hall (Hall-1)				7 PS
E-12	" "	" under pink carpet "				7 PS
E-13	12x12 FT / mastic	BOA Hall (Hall-1)			245 SF	7 PS Separate
E-14	" "	" "			"	7 PS Layers
E-15	carpet mastic	Blue carpet squares (RM 3)				7 PS
E-16	" "	" "				7 PS
E-17	ceiling tile	Rm 10				7 PS
E-18	" "	" "				7 PS

1200495



ASBESTOS BULK SAMPLE SHEET

Job Order No: 151112.36 Location: ABC / Board of Elections Date: 1-10-12

Inspector: WSC Signature: \_\_\_\_\_ Page: 2 of 3

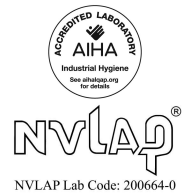
Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good/ Damaged	Quantity	Remarks
E-19	SR / JC	throughout BOE				] PS- one <sup>composite</sup> sample
E-20	SR / JC	throughout BOE				
F-21	vinyl floor	kitchen floor			126.5 SF	] PS
E-22	vinyl floor	" "				] PS
E-23	vinyl floor	under cabinets			24 SF	] PS
E-24	vinyl floor	" "				] PS
E-25	Grey FT / mastic	ABC Storehouse RestRoom Hall			80 SF	] PS Separate layers
E-26	" "	" " "				] PS Separate layers
E-27	Conc Base / mastic Blue	ABC Storehouse RestRoom Hall				] PS Separate layers
E-28	" "	" " "				] PS Separate layers
E-29	carpet mastic	ABC store office				] PS
E-30	" "	" " "				] PS
E-31	Conc Base grey / mastic	ABC Store office				] PS Separate layers
F-32	" " " "	" " "				] PS Separate layers
E-33	2'x2' Ceiling tile white dots	ABC store / office				] PS
E-34	" " " "	" " "				] PS
E-35	Ext Door Caulking	EXT DOOR ABC store				] PS
E-36	" " "	" " "				] PS





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200495

**Analysis ID:** 1200495\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set E ABC/Board of  
Elections

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
E-1	Carpet mastic	None Detected	2% Cellulose 2% Synthetic Fibers	96% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_1					Dissolved
E-2	Carpet mastic	None Detected	3% Synthetic Fibers 2% Cellulose	95% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_2					Dissolved
E-3 - A	Cove base/mastic	None Detected		100% Other	Black Non Fibrous Homogeneous
1200495PLM_3	cove base				Ashed
E-3 - B	Cove base/mastic	None Detected	2% Cellulose	98% Other	Brown, Tan Non Fibrous Heterogeneous
1200495PLM_43	mixed mastics				Dissolved
E-4 - A	Cove base/mastic	None Detected		100% Other	Black Non Fibrous Homogeneous
1200495PLM_4	cove base				Ashed
E-4 - B	Cove base/mastic	None Detected	3% Cellulose	97% Other	Brown, Tan Fibrous Heterogeneous
1200495PLM_44	mixed mastics				Dissolved
E-5	Ceiling tile 2x2 grey stucco	None Detected	80% Mineral Wool	20% Other	White Fibrous Heterogeneous
1200495PLM_5					Crushed
E-6	Ceiling tile 2x2 grey stucco	None Detected	80% Mineral Wool	20% Other	White Fibrous Heterogeneous
1200495PLM_6					Crushed

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Dorlos Ammerman (53)

Analyst

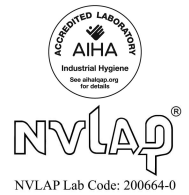
Approved Signatory





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EPA Method: 600/R-93/116 and 600/M4-82-020



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Elections

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
E-7	Ceiling tile 2x2 white	<b>None Detected</b>	40% Cellulose 40% Fiber Glass	10% Perlite 10% Other	White, Tan Fibrous Heterogeneous
1200495PLM_7					Crushed
E-8	Ceiling tile 2x2 white	<b>None Detected</b>	40% Cellulose 40% Fiber Glass	10% Perlite 10% Other	White, Tan Fibrous Heterogeneous
1200495PLM_8					Crushed
E-9	Ceiling tile 2x2 white	<b>None Detected</b>	50% Cellulose 30% Fiber Glass	10% Perlite 10% Other	White, Tan Fibrous Heterogeneous
1200495PLM_9					Crushed
E-10	Ceiling tile 2x2 white	<b>None Detected</b>	50% Cellulose 30% Fiber Glass	10% Perlite 10% Other	White, Gray Fibrous Heterogeneous
1200495PLM_10					Crushed
E-11	Carpet mastic	<b>None Detected</b>		100% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_11					Dissolved
E-12	Carpet mastic	<b>None Detected</b>		100% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_12					Dissolved
E-13 - A	12x12 FT/mastic	<b>3% Chrysotile</b>		97% Other	Tan Non Fibrous Heterogeneous
1200495PLM_13	tile				Dissolved
E-13 - B	12x12 FT/mastic	<b>8% Chrysotile</b>		92% Other	Black Non Fibrous Heterogeneous
1200495PLM_45	mastic				Dissolved

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Dorlos Ammerman (53)

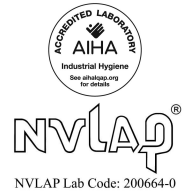
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
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**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set E ABC/Board of  
Elections

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
E-14 - A	12x12 FT/mastic	Not Analyzed			
1200495PLM_14	tile				
E-14 - B	12x12 FT/mastic	Not Analyzed			
1200495PLM_46	mastic				
E-15	Carpet mastic	None Detected	3% Synthetic Fibers	97% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_15					Dissolved
E-16	Carpet mastic	None Detected	3% Synthetic Fibers 2% Cellulose	95% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_16					Dissolved
E-17	Ceiling tile	None Detected	12% Cellulose 3% Fiber Glass	85% Other	White, Tan Fibrous Heterogeneous
1200495PLM_17					Crushed
E-18	Ceiling tile	None Detected	12% Cellulose 3% Fiber Glass	85% Other	White, Tan Fibrous Heterogeneous
1200495PLM_18					Crushed
E-19	SR/JC	None Detected	15% Cellulose	85% Other	White, Tan Fibrous Heterogeneous
1200495PLM_19	sheetrock: none detect; joint compnd: none detect				Crushed
E-20	SR/JC	None Detected	15% Cellulose	85% Other	White, Tan Fibrous Heterogeneous
1200495PLM_20	sheetrock: none detect; joint compnd: none detect				Crushed

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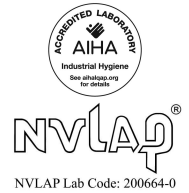
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200495

**Analysis ID:** 1200495\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set E ABC/Board of  
Elections

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
E-21 - A	Vinyl floor	None Detected	15% Cellulose 5% Fiber Glass	80% Other	White Fibrous Heterogeneous
1200495PLM_21	vinyl				Dissolved
E-21 - B	Vinyl floor	None Detected		100% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_47	mastic				Dissolved
E-22	Vinyl floor	None Detected	15% Cellulose 5% Fiber Glass	80% Other	White Fibrous Heterogeneous
1200495PLM_22	vinyl only				Dissolved
E-23	Vinyl floor	None Detected		100% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_23					Dissolved
E-24	Vinyl floor	None Detected		100% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_24					Dissolved
E-25 - A	Grey FT/mastic	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200495PLM_25	tile				Dissolved
E-25 - B	Grey FT/mastic	8% Chrysotile		92% Other	Black Non Fibrous Heterogeneous
1200495PLM_48	mastic				Dissolved
E-26 - A	Grey FT/mastic	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200495PLM_26	tile				Dissolved

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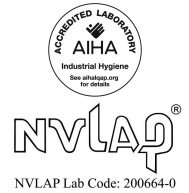
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EPA Method: 600/R-93/116 and 600/M4-82-020



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**Date Received:** 1/12/2012

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**Project:** 15111236 IHG-00 Set E ABC/Board of  
Elections

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
E-26 - B	Grey FT/mastic	Not Analyzed			
1200495PLM_49	mastic				
E-27	Cove base / mastic blue	None Detected		100% Other	Blue Non Fibrous Homogeneous
1200495PLM_27	cove base only				Ashed
E-28	Cove base / mastic blue	None Detected		100% Other	Blue Non Fibrous Homogeneous
1200495PLM_28	cove base only				Ashed
E-29	Carpet mastic	None Detected	3% Synthetic Fibers	97% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_29					Dissolved
E-30	Carpet mastic	None Detected	2% Synthetic Fibers	98% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_30					Dissolved
E-31	Cove base grey/mastic	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200495PLM_31	cove base only				Ashed
E-32	Cove base grey/mastic	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200495PLM_32	cove base only				Ashed
E-33	Ceiling tile 2'x2' white dots	None Detected	50% Cellulose 30% Fiber Glass	10% Perlite 10% Other	White, Tan Fibrous Heterogeneous
1200495PLM_33					Crushed

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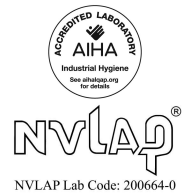
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**Analysis ID:** 1200495\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set E ABC/Board of  
Elections

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
E-34	Ceiling tile 2'x2' white dots	None Detected	50% Cellulose 30% Fiber Glass	10% Perlite 10% Other	White, Tan Fibrous Heterogeneous
1200495PLM_34					Crushed
E-35	Ext door caulking	None Detected		100% Other	Black Non Fibrous Heterogeneous
1200495PLM_35					Dissolved
E-36	Ext door caulking	None Detected		100% Other	Black Non Fibrous Heterogeneous
1200495PLM_36					Dissolved
E-37 - A	Carpet mastic/leveling comp	None Detected	2% Synthetic Fibers	98% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_37	mastic				Dissolved
E-37 - B	Carpet mastic/leveling comp	None Detected	2% Cellulose	98% Other	White Non Fibrous Heterogeneous
1200495PLM_50	leveling				Crushed
E-38 - A	Carpet mastic/leveling comp	None Detected	2% Synthetic Fibers	98% Other	Yellow Non Fibrous Heterogeneous
1200495PLM_38	mastic				Dissolved
E-38 - B	Carpet mastic/leveling comp	None Detected	2% Cellulose	98% Other	White Non Fibrous Heterogeneous
1200495PLM_51	leveling				Crushed
E-39 - A	FT/mastic	3% Chrysotile		97% Other	Tan Non Fibrous Heterogeneous
1200495PLM_39	tile				Dissolved

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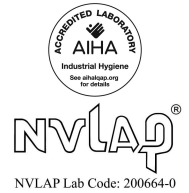
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**Project:** 15111236 IHG-00 Set E ABC/Board of  
Elections

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
E-39 - B	FT/mastic	8% Chrysotile		92% Other	Black Non Fibrous Heterogeneous
1200495PLM_52	mastic				Dissolved
E-40 - A	FT/mastic	Not Analyzed			
1200495PLM_40	tile				
E-40 - B	FT/mastic	Not Analyzed			
1200495PLM_53	mastic				
E-41	JC	None Detected		100% Other	White Non Fibrous Homogeneous
1200495PLM_41					Crushed
E-42	JC	None Detected		100% Other	White Non Fibrous Homogeneous
1200495PLM_42					Crushed

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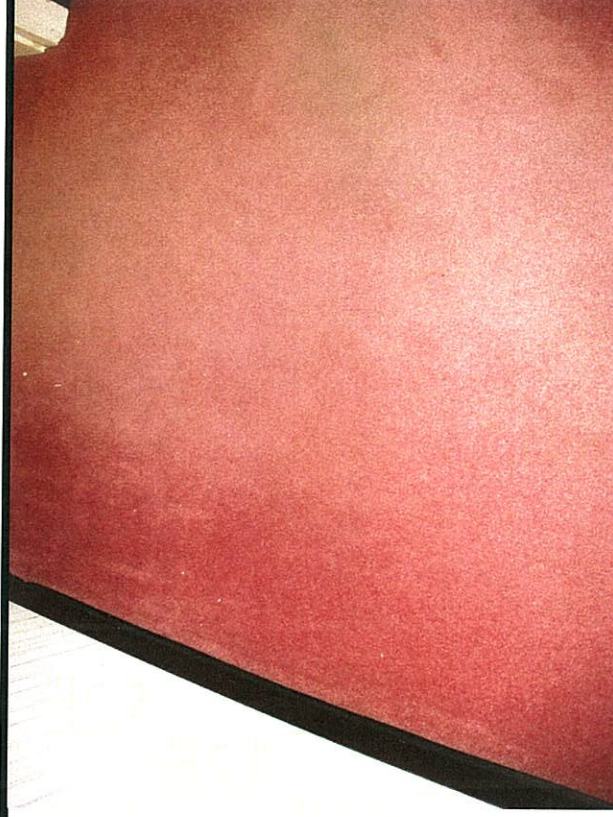
### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA
E1	drywall	wall d	blue wallpaper	room 1	0.01	no
E2	drywall	wall b	blue wallpaper	room 1	0.00	no
E3	drywall	wall b	tan	room 1	0.00	no
E4	metal	door frame	cream	room 1	0.01	no
E5	wood	door frame	cream	room 12	0.00	no
E6	concrete	wall b	cream	room 12	0.05	no
E7	plaster	wall a	cream	room 12	0.00	no
E8	metal	door	brown	room 12	0.01	no
E9	drywall	wall b	cream	room 11	0.00	no
E10	drywall	wall a	pink wallpaper	hallway 1	0.04	no
E11	wood	door frame	cream	room 8	0.00	no
E12	drywall	wall b	white	room 7	0.00	no
E13	drywall	wall c	white	room 6	0.00	no
E14	wood	door frame	cream	room 3	0.00	no
E15	drywall	wall c	tan/blue wallpa	room 4	0.02	no
E16	drywall	wall b	tan	main lobby of ABC office	0.04	no
E17	wood	door frame	whtie	room 5	0.00	no
E18	concrete	wall c	cream	ABC warehouse	0.00	no
E19	concrete	wall a	red	ABC warehouse	0.02	no
E20	metal	railing	brown	ABC warehouse	0.00	no
E21	metal	beam	brown	ABC warehouse	0.40	no
E22	metal	door frame	white	room 5	0.00	no
E23	metal	door frame	brown	ABC warehouse	0.00	no
E24	drywall	wall a	cream	ABC warehouse storage area	0.01	no
E25	drywall	wall c	cream	ABC warehouse hallway	0.01	no
E26	drywall	wall c	cream	ABC packaging office	0.00	no
E27	drywall	wall c	white	ABC back office	0.00	no
E28	wood	door frame	blue	ABC storage office	0.00	no
E29	drywall	wall	light gray	hallway 2	0.00	no
E30	metal	door	blue	entrance to warehouse	0.04	no
Cal4		SRM - 2579	Red	Calibration Test	1.10	NA
Cal5		SRM - 2579	Red	Calibration Test	1.10	NA
Cal6		SRM - 2579	Red	Calibration Test	1.10	NA





Elections/ABC Building. Assume all roofing components and mastic as asbestos containing



Asbestos containing 12 inch tan floor tile and floor tile mastic located under pink carpet in Hallway 1 of the BOE offices



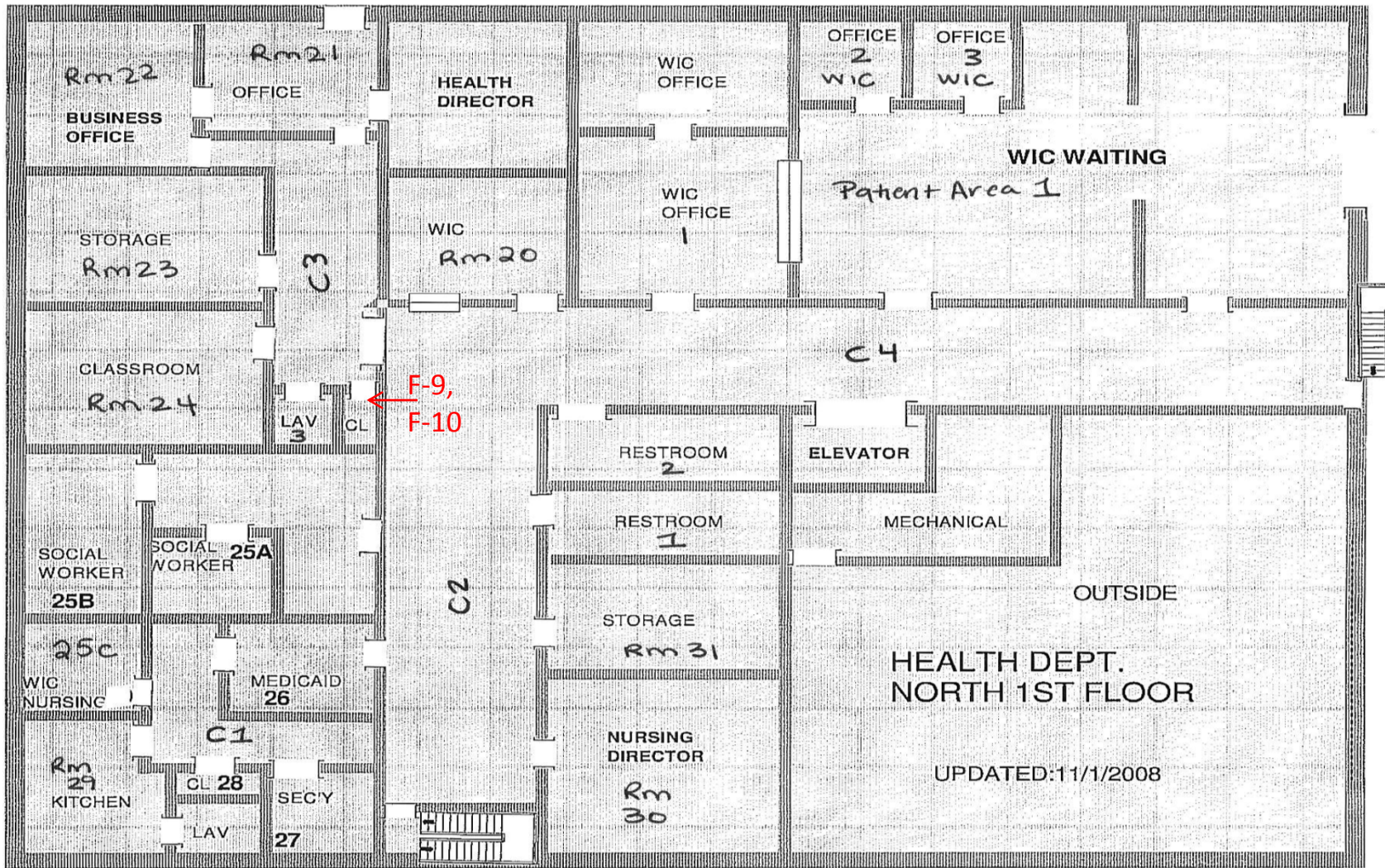
Asbestos containing Mastic located underneath floor tile



Asbestos containing Floor tile and Floor tile mastic located in the ABC Board offices section.



**(F) HEALTH DEPARTMENT**



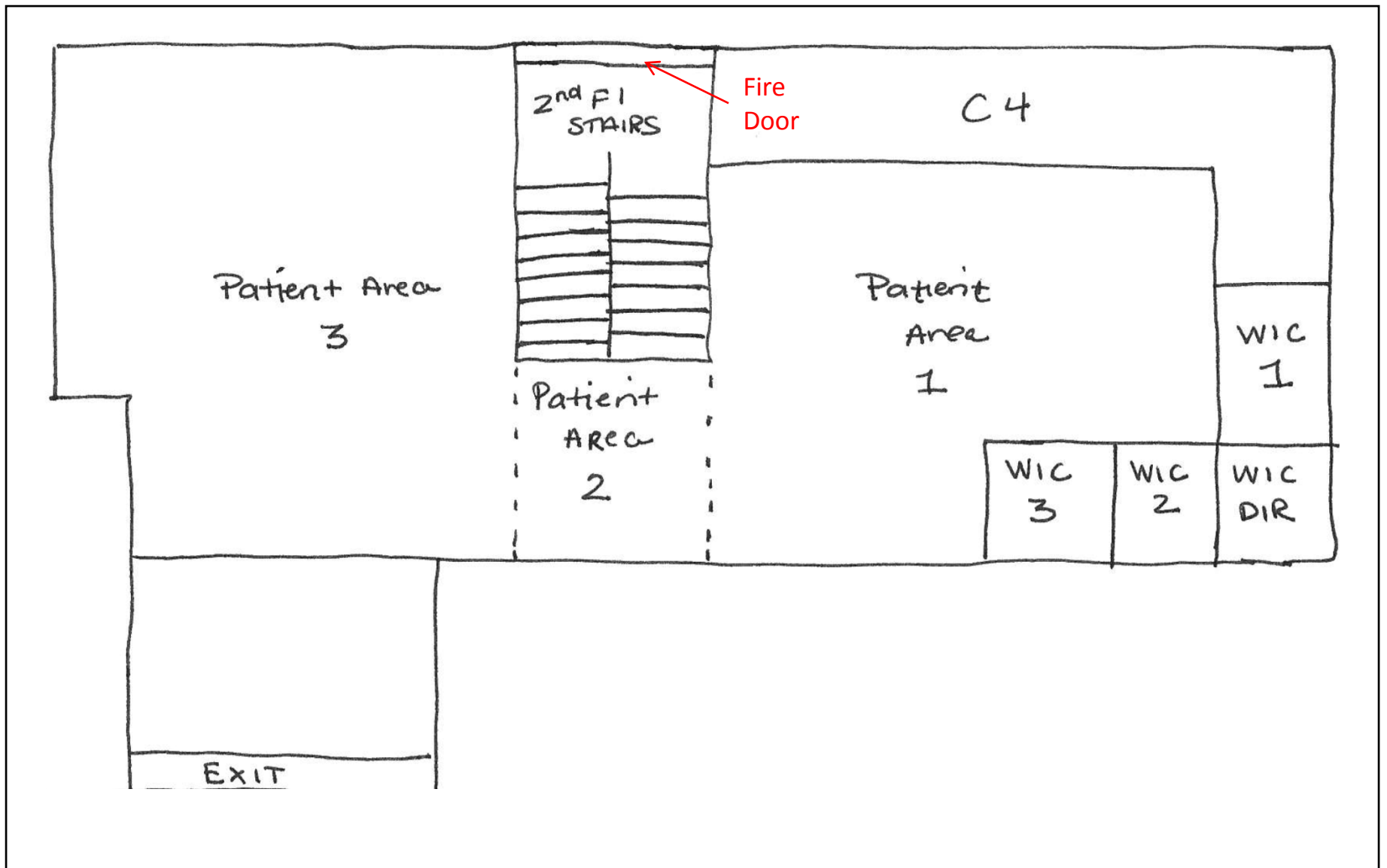
UPDATED: 11/1/2008

**North 1st Floor**

**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Notes:**  
 1700 SF of asbestos-containing tan floor tile  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



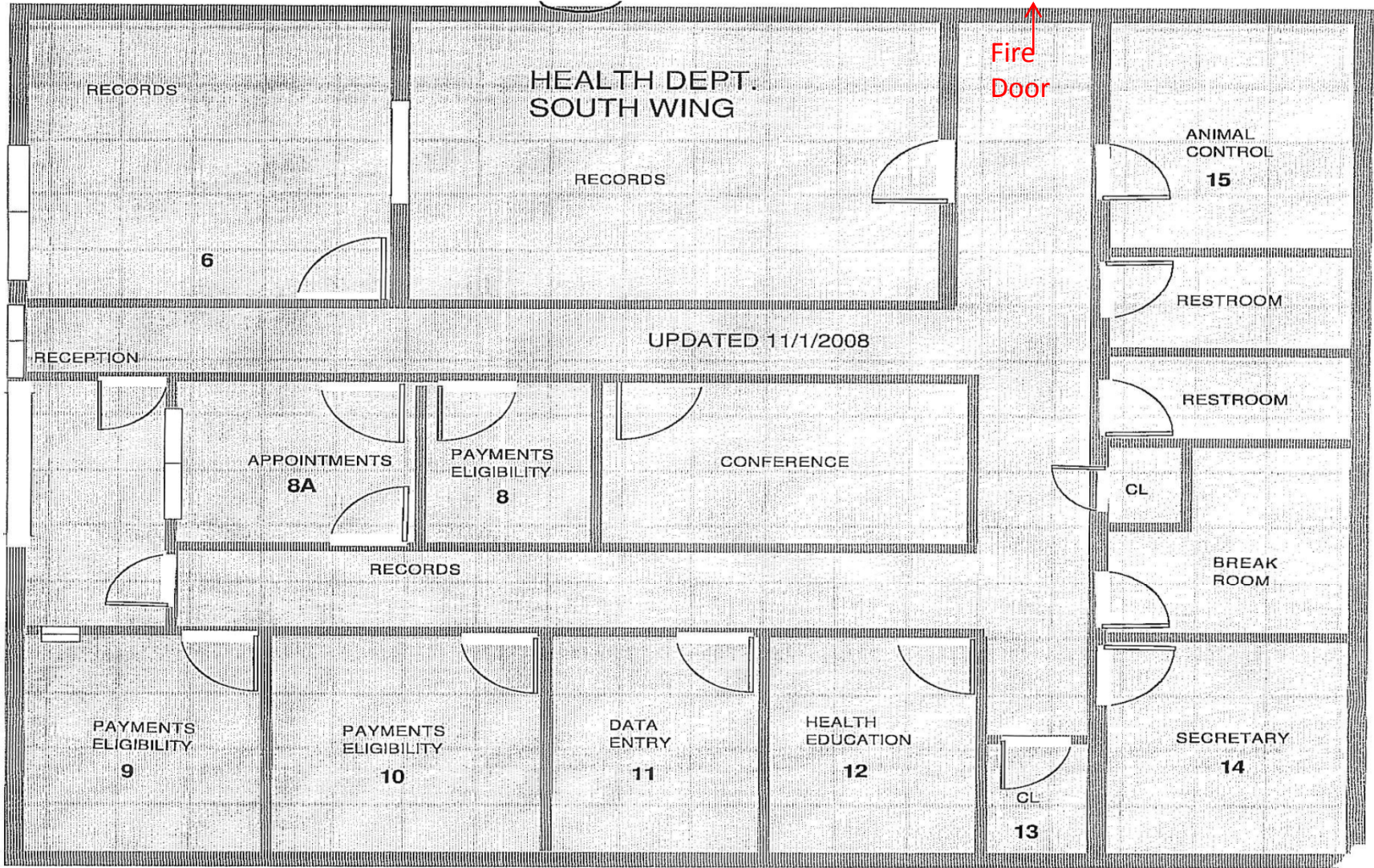
Prepared by  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Main Entrance Lobby**

Notes:  
 1700 SF of asbestos-containing tan floor tile  
 Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



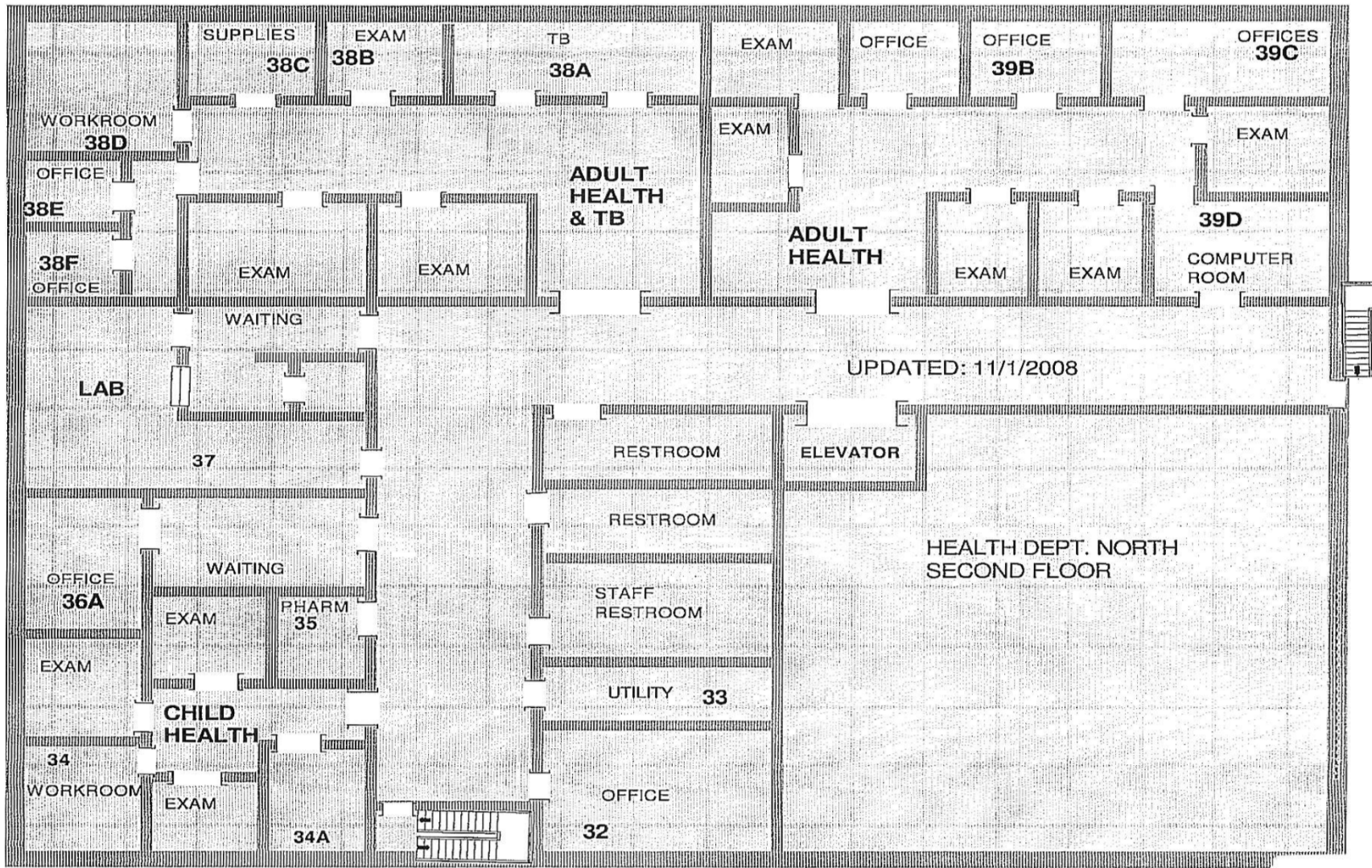


**Prepared by**  
KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

**South Wing**  
**Notes:**  
Floor Plan to be used for purpose of this report only

**Prepared for**  
County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502





Prepared by  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**North Wing Second Floor**

Notes:  
 Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200492

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone <input type="checkbox"/> : 410.891.1726
4601 Six Forks Rd., 220	Fax <input type="checkbox"/> : 410316.7935
Raleigh, NC 27609	Email <input type="checkbox"/> : tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

<b>PO Number:</b>
<b>Project Name/Number:</b> 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 10 sets.			
set B	Sample # B-1 to B-23		- Please apply positive stop as indicated on sampling datasheets.
set C	Sample # C-1 to C-30		
set D	Sample # D-1 to D-6		
set E	Sample # E-1 to E-42		
set F	Sample # F-1 to F-32		
set G	Sample # G-1 to G-36		- Please separate layers for Floor Tile and Mastic & Plaster samples.
set H	Sample # H-1 to H-48		
set I	Sample # I-1 to I-11		
set J	Sample # J-1 to J-31		- Please provide separate reports for each set of samples.
set K	Sample # K-1 to K-42.		

Total # of Samples \_\_\_\_\_

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/11/2012.		1-12 9:30A

Page \_\_\_ of \_\_\_

Accepted   
 Rejected

1200492



## ASBESTOS BULK SAMPLE SHEET

Job Order No: 15111236. Location: Health Department. Date: 1/11/2012.  
 Inspector: Tehsin Aurangabadiwala. Signature: Tehsin Page: 1 of 2

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good/ Damaged	Quantity	Remarks
F-1	Corebase - Brown.	1st Floor - Break Room.		Good.		JPS
F-2	Corebase - Brown	1st Floor - Break Room.				J
F-3	Mastic - Yellow	behind 1				JPS
F-4	Mastic - Yellow	behind 2				J
F-5	12" Floor Tile - white w/brown streaks.	Corridor by Rm 80				JPS
F-6	12" Floor Tile - white w/brown streak	Corridor by Rm 80.				J
F-7	Mastic - brown/black.	beneath 6				JPS
F-8	Mastic - brown/black.	beneath 6.				J
F-9	12" Floor Tile - <sup>Fan</sup> beige w/brown streak	Rm 80 (Closet)				JPS
F-10	12" Floor Tile - <sup>Tan</sup> beige w/brown streak	Rm 80 (Closet).				J
F-11	Mastic brown/black	beneath 9				JPS
F-12	Mastic - brown/black.	beneath 10.				J
F-13	Carpet Mastic - Yellow	Rm 21				JPS
F-14	Carpet Mastic - Yellow.	Rm 22.				J
F-15	2x4 Ceiling Tile	Corridor C4.				JPS
F-16	2x4 Ceiling Tile.	1st Floor Stair				J
F-17	Drywall / Joint Compd.	6 1st Floor Stair landing (wall)				JPS
F-18	Drywall / Joint Compd.	1st Floor, Closet near Stair.				J

1200492



## ASBESTOS BULK SAMPLE SHEET

Job Order No: 15111236 Location: Health Department. Date: 1/11/2012  
 Inspector: Tehsin Aurangabadwala Signature: Tehsin Page: 2 of 2

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
F-19	Plaster - skin	1st Floor. North Wing. Corridor ↓				PS - all skin and all base.
F-20	Plaster - base					
F-21	Plaster - skin					
F-22	Plaster - base					
F-23	Plaster - skin					
F-24	Plaster - base					
F-25	Plaster - skin					
F-26	Plaster - base					
F-27	Plaster - skin					
F-28	Plaster - base					
F-29	2x4 Ceiling Tile	South Wing. 1st Floor. <sup>Corridor.</sup> Janitor's Room by Breakroom.				PS
F-30	2x4 Ceiling Tile	" " " " " "				
F-31	Drywall / Joint Compound	South wing 1st Floor - Janitor's Closet.				PS
<del>F-32</del>	Drywall / Joint Compd.	South wing 1st Floor - Janitor's Closet.				
<del>33</del>	Drywall / Joint Compd.	South wing 1st Floor - Janitor's Closet.				





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200492

**Analysis ID:** 1200492PLM

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set F Health  
Department

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
F-1	Covebase-brown	None Detected		100% Other	Black, Brown Non Fibrous Homogeneous
1200492PLM_1					Ashed
F-2	Covebase-brown	None Detected		100% Other	Black, Brown Non Fibrous Homogeneous
1200492PLM_2					Ashed
F-3	Mastic-yellow	None Detected		100% Other	Yellow Non Fibrous Heterogeneous
1200492PLM_3					Ashed
F-4	Mastic-yellow	None Detected		100% Other	Yellow Non Fibrous Heterogeneous
1200492PLM_4					Ashed
F-5	12" floor tile-white w/ brown streaks	None Detected		100% Other	White, Brown Non Fibrous Heterogeneous
1200492PLM_5					Dissolved
F-6	12" floor tile-white w/ brown streaks	None Detected		100% Other	Brown Non Fibrous Heterogeneous
1200492PLM_6					Dissolved
F-7	Mastic-brown/black	None Detected	10% Cellulose	90% Other	Black, Brown Non Fibrous Heterogeneous
1200492PLM_7	mixed mastics				Dissolved
F-8	Mastic-brown/black	None Detected	10% Cellulose	90% Other	Black, Brown Non Fibrous Heterogeneous
1200492PLM_8	mixed mastics				Dissolved

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Byron Stroble (31)

Analyst

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888

Nathaniel Durham, MS or Approved Signatory

Page 1 of 4



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200492

**Analysis ID:** 1200492PLM

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set F Health  
Department

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
F-9	12" floor tile-tan w/brown streak	3% Chrysotile		97% Other	Tan, Brown Non Fibrous Heterogeneous
1200492PLM_9					Dissolved
F-11	Mastic-brown/black	None Detected	10% Cellulose 10% Synthetic Fibers	80% Other	Black, Brown Non Fibrous Heterogeneous
1200492PLM_11	mixed mastics				Dissolved
F-12	Mastic-brown/black	None Detected	10% Cellulose 10% Synthetic Fibers	80% Other	Black, Brown Non Fibrous Heterogeneous
1200492PLM_12	mixed mastics				Dissolved
F-13	Carpet mastic-yellow	None Detected	5% Cellulose	95% Other	Yellow Non Fibrous Heterogeneous
1200492PLM_13					Dissolved
F-14	Carpet mastic-yellow	None Detected	5% Cellulose	95% Other	Yellow Non Fibrous Heterogeneous
1200492PLM_14					Dissolved
F-15	2x4 ceiling tile	None Detected	40% Cellulose 40% Mineral Wool	10% Perlite 10% Other	Grayish, White Fibrous Heterogeneous
1200492PLM_15					Teased
F-16	2x4 ceiling tile	None Detected	40% Cellulose 40% Mineral Wool	10% Perlite 10% Other	Grayish, White Fibrous Heterogeneous
1200492PLM_16					Teased
F-17	Drywall/joint compd	None Detected	10% Cellulose	90% Other	White, Brown Non Fibrous Heterogeneous
1200492PLM_17	drywall: none detect; joint compnd: none detect				Teased

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Byron Stroble (31)

Analyst

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888

Nathaniel Durham, MS or Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200492

**Analysis ID:** 1200492PLM

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set F Health  
Department

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
F-18	Drywall/joint compd	None Detected	10% Cellulose	90% Other	White, Brown Non Fibrous Heterogeneous
1200492PLM_18	<i>drywall: none detect; joint compnd: none detect</i>				Teased
F-19	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200492PLM_19	<i>finish</i>				Teased
F-20	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200492PLM_20	<i>base</i>				Crushed
F-21	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200492PLM_21	<i>finish</i>				Teased
F-22	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200492PLM_22	<i>base</i>				Crushed
F-23	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200492PLM_23	<i>finish</i>				Teased
F-24	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200492PLM_24	<i>base</i>				Crushed
F-25	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200492PLM_25	<i>finish</i>				Teased

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Byron Stroble (31)

Analyst

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Nathaniel Durham, MS or Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200492

**Analysis ID:** 1200492PLM

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set F Health  
Department

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
F-26	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200492PLM_26	base				Crushed
F-27	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200492PLM_27	finish				Teased
F-28	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200492PLM_28	base				Crushed
F-29	2x4 ceiling tile	None Detected	40% Cellulose 40% Mineral Wool	10% Perlite 10% Other	Grayish, White Fibrous Heterogeneous
1200492PLM_29					Teased
F-30	2x4 ceiling tile	None Detected	40% Cellulose 40% Mineral Wool	10% Perlite 10% Other	Grayish, White Fibrous Heterogeneous
1200492PLM_30					Teased
F-31	Drywall/joint compound	None Detected	10% Cellulose	90% Other	White, Brown Non Fibrous Heterogeneous
1200492PLM_31	drywall: none detect; joint compnd: none detect				Teased
F-32	Drywall/joint compound	None Detected	10% Cellulose	90% Other	White, Brown Non Fibrous Heterogeneous
1200492PLM_32	drywall: none detect; joint compnd: none detect				Teased

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Byron Stroble (31)

Analyst

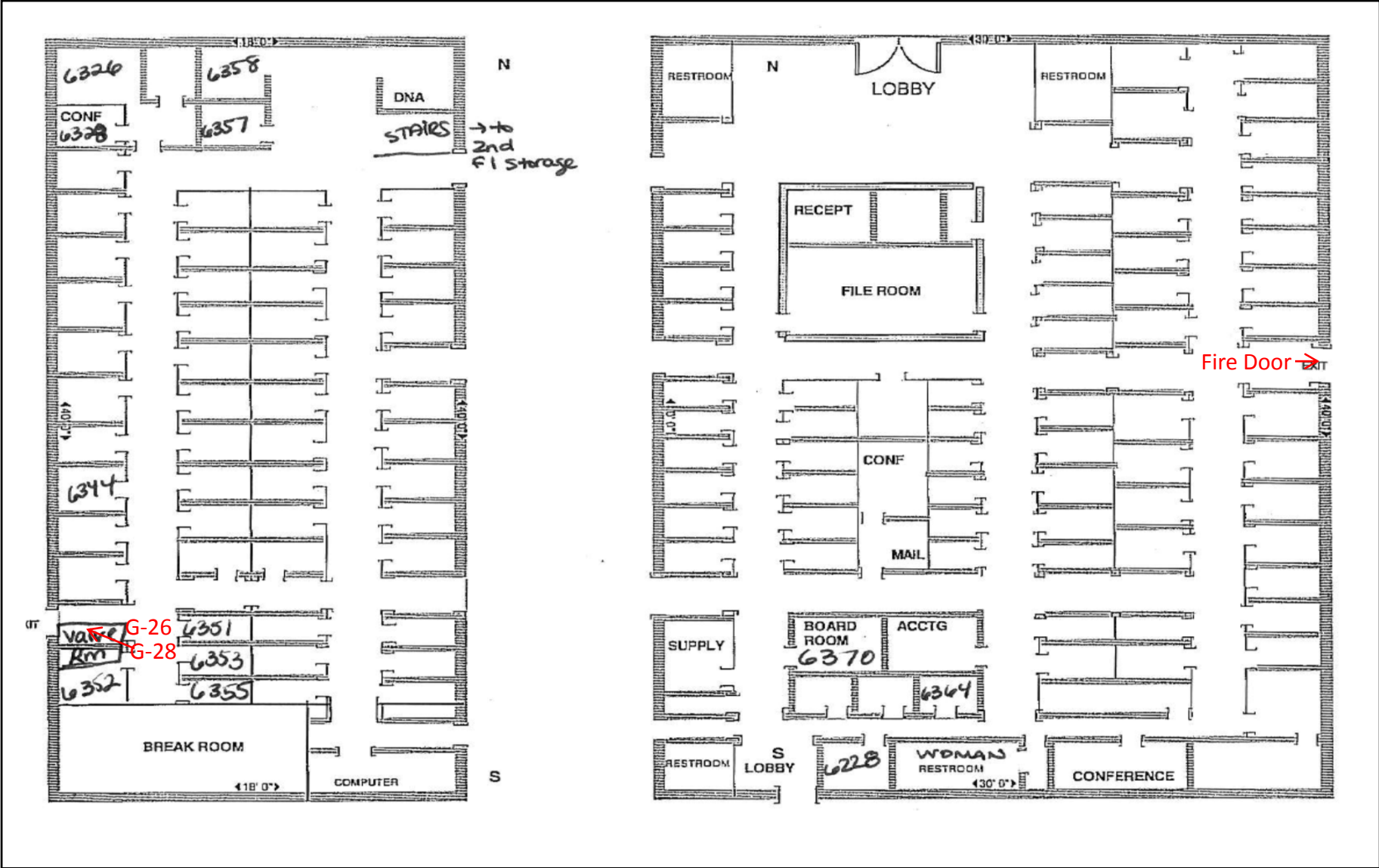
Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888

Nathaniel Durham, MS or Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA
F-1	plaster	wall d	white	break room	0.00	no
F-2	wood	window frame	white	break room	0.00	no
F-3	wood	wall d	white	break room	0.01	no
F-4	wood	door	white	break room	0.00	no
F-5	drywall	wall b	pink	breast feeding office	0.00	no
F-6	drywall	wall c	yellow	room 27	0.00	no
F-7	wood	railing	brown	stairs near room 27	0.04	no
F-8	wood	railing	white	stairs near room 27	0.50	no
F-9	drywall	wall a	white	stairs near room 27	0.20	no
F-10	plaster	wall b	light green	nursing director office	0.01	no
F-11	drywall	wall b	white	hallway C2	0.01	no
F-12	drywall	wall c	white	women's bathroom C2	0.05	no
F-13	drywall	wall b	tan	C3 hallway	0.04	no
F-14	plaster	wall c	lime green	room 20	0.00	no
F-15	drywall	wall c	sea green	WIC office	0.00	no
F-16	drywall	wall b	lime yellow	WIC office	0.00	no
F-17	brick	wall d	white	stairway near C4	0.13	no
F-18	drywall	wall a	white	women's health room 39	0.00	no
F-19	drywall	wall b	tan	adult health room 38 B	0.00	no
F-20	drywall	wall a	blue	room 34 A	0.00	no
F-21	plaster	wall b	light green	next to room 34B	0.02	no
F-22	wood	window frame	white	next to room 34B	0.10	no
F-23	drywall	wall	purple	room 34 C	0.00	no
F-24	wood	window sill	white	stairs near room 32	0.00	no
F-25	plaster	wall	white	stairs near room 27	0.00	no
F-26	drywall	wall c	yellow	room 6B	0.00	no
F-27	wood	door	cream	room 6 main area	0.00	no
F-28	plaster	wall b	white	room 6 main area	0.00	no
F-29	wood	window sill	white	room 6A	0.00	no
F-30	drywall	wall	tan	conference room near 6A	0.00	no
F-31	drywall	wall a	light tan	bathroom across from room 16	0.01	no
F-32	drywall	wall	light green	secretary supervisor office	0.00	no
F-33	wood	window sill	white	room 11 data entry	0.00	no
F-34	drywall	wall	white	room 9 payments/eligibility	0.00	no
F-35	concrete	wall	green	exterior of main entrance	0.00	no
F-36	met	door	cream	exterior of electric room	0.00	no
F-37	concrete	wall	cream	exterior of side entrance	0.00	no
Cal1		SRM - 2579	Red	Calibration Test	1.00	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA

**(G) SOCIAL SERVICES**



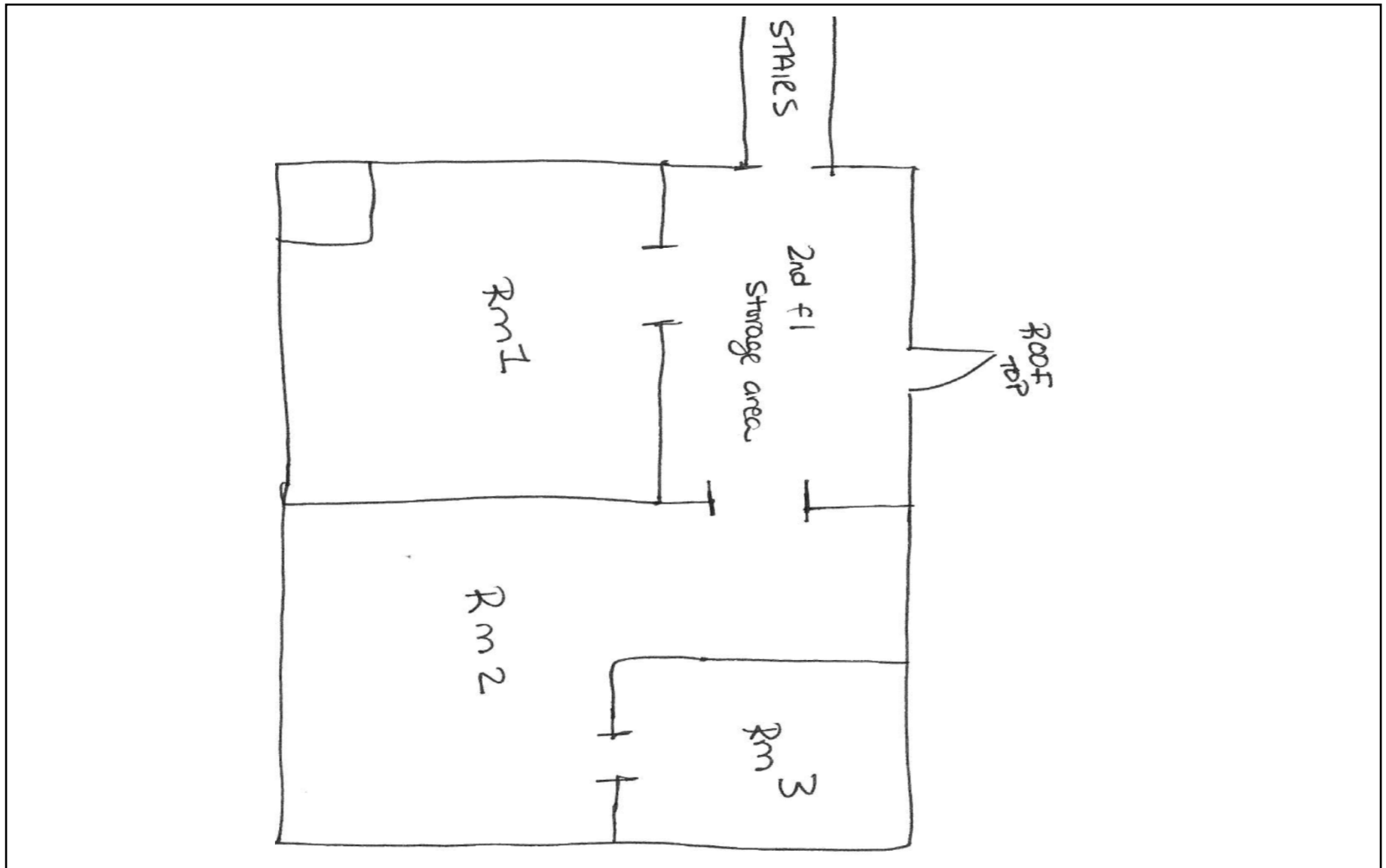
**Prepared by**

KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Social Service 1<sup>st</sup> Floor**

Notes:  
 2,250 SF of asbestos-containing mastic (black ) beneath 12" green floor tiles.  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Social Services 2<sup>nd</sup> Floor**  
 Notes:  
 40 SF of asbestos-containing 9" beige floor tiles and associated mastic in Rm 3  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502





**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200496

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone <input type="checkbox"/> : 410.891.1726
4601 Six Forks Rd., 220	Fax <input type="checkbox"/> : 410316.7935
Raleigh, NC 27609	Email <input type="checkbox"/> : tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHRA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number: \_\_\_\_\_  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached	Sampling Datasheets for 10 sets.		
set B	Sample # B-1 to B-23	-	Please apply positive stop as indicated on sampling datasheets.
set C	Sample # C-1 to C-30		
set D	Sample # D-1 to D-6		
set E	Sample # E-1 to E-42		
set F	Sample # F-1 to F-32	-	Please separate layers for Floor Tile and Mastic & Plaster samples.
set G	Sample # G-1 to G-36		
set H	Sample # H-1 to H-48		
set I	Sample # I-1 to I-11		
set J	Sample # J-1 to J-31	-	Please provide separate reports for each set of samples.
set K	Sample # K-1 to K-42.		

Total # of Samples \_\_\_\_\_

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/11/2012		1-12 9:30A

Accepted   
 Rejected

Page \_\_\_ of \_\_\_

1200496



## ASBESTOS BULK SAMPLE SHEET

Social Services

Job Order No: 15111236

Location:

Date: 1/10/2012

Inspector: Tehsin Aurangabadwala.

Signature:

Page:

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good/ Damaged	Quantity	Remarks
PS [ G-1	DW/JC	2nd Floor - Storage Rm.				
G-2	DW/JC	" " " "				
PS [ G-3	Plaster - skim					
G-4	Plaster - base					
G-5	Plaster - skim					
G-6	Plaster - base					
G-7	Plaster - skim					
G-8	Plaster base					
PS [ G-9	1x1 Ceiling Tile - Spline	Stairs to 2nd Floor Storage			40 SF	
G-10	1x1 Ceiling Tile - Spline	" " " " "				
PS [ G-11	linoleum Flooring - Yellow	2nd Floor Storage - hallway				
G-12	linoleum Flooring Yellow	2nd Floor Storage Rm 1				
PS [ G-13	Mastic - Yellow	beneath G-11				
G-14	Mastic - Yellow	beneath G-12				
include with G-3-G-8 [ G-15	Plaster - skim	2nd Floor Storage Rm 2				
G-16	Plaster - base	2nd Floor Storage Rm 2				
G-17	Plaster - skim	2nd Floor Storage Rm 3				
G-18	Plaster - base	2nd Floor Storage Rm 3.				

1200496



## ASBESTOS BULK SAMPLE SHEET

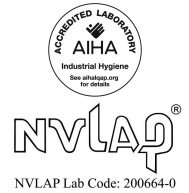
Job Order No: 15111236 Location: Social Services Date: 1/10/2012  
 Inspector: Tehsin Aurangabadwala Signature: \_\_\_\_\_ Page: \_\_\_\_\_

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good/ Damaged	Quantity	Remarks
<del>G-19</del>	9" <sup>Floor</sup> Tiles - beige	not Sampled: 2nd Floor, Rm 3.		G.	16 + 16	
PS [ G-19	Mastic - brown.	Stairs to 2nd Floor Storage		G.		
G-20	Mastic - brown	Stairs to 2nd Floor Storage		G.	SF. 40	
PS [ G-21	Carpet Mastic beige	1 <sup>st</sup> Floor - Entrance to Stairs for Storage on 2nd Floor.		G.	[40 x 18]	Entire 1st Fl.
G-22	Carpet Mastic - beige	1 <sup>st</sup> Floor - Office by Stairs to 2nd Fl.		G.	[40 x 30]	
PS [ G-23	Covebase Mastic - Yellow	1 <sup>st</sup> Floor Entrance to Stairs for 2nd Floor.		G.		
G-24	Covebase Mastic - Yellow.	1 <sup>st</sup> Floor - Office by Stairs to 2nd Floor.		G.		
PS [ G-25	12" Floor Tile - Green.	1 <sup>st</sup> Floor - Valve Rm next to off 6352		G.	25 + 40 + 70	Boiler Rm. Valve Rm, BK Room, File Rm
PS [ G-26	Mastic - black	1 <sup>st</sup> Floor - " " " " "		G.	+60 + 60 + 144	
PS [ G-27	12" Floor Tile - Green	1 <sup>st</sup> Floor - Boiler Rm (next to Breakroom)		G.		
G-28	Mastic - Black	1 <sup>st</sup> Floor - Boiler Rm. " " "		G.		
PS [ G-29	2x4 Ceiling Tiles - white	1 <sup>st</sup> Floor Boiler Rm (next to break room)		G.	40 x 18 +	Entire 1st Floor. Fiberglass ins. on pipes (pic.)
G-30	2x4 Ceiling Tiles - white	1 <sup>st</sup> Floor Corridor by Break Rm.		G.	40 x 30	
PS [ G-31	2x4 Ceiling Tile - tan	1 <sup>st</sup> Floor break Rm Corridor		G.		
G-32	2x4 Ceiling Tile tan	1 <sup>st</sup> Floor break Rm		G.		
PS [ G-33	Window Caulk - brown	Exterior - (North side of bldg)		G.		
G-34	Window Caulk - brown	Exterior - (East of bldg) Rear Entr.		G.		
PS [ G-35	Cove base - Grey	1st Floor Entrance to Stairs				
G-36	Cove base - Grey	1st Floor office by Stairs				



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200496

**Analysis ID:** 1200496\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set G Social Services

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
G-1	DW/JC	None Detected	10% Cellulose	90% Other	Brown, Gray Non Fibrous Heterogeneous
1200496PLM_1	drywall only				Teased
G-2	DW/JC	None Detected	10% Cellulose	90% Other	Brown, Gray Non Fibrous Heterogeneous
1200496PLM_2	drywall only				Teased
G-3	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200496PLM_3					Teased
G-4	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200496PLM_4					Crushed
G-5	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200496PLM_5					Teased
G-6	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200496PLM_6					Crushed
G-7	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200496PLM_7					Teased
G-8	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200496PLM_8					Crushed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Byron Stroble (36)

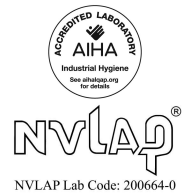
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200496

**Analysis ID:** 1200496\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set G Social Services

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
G-9	1x1 ceiling tile - spline	None Detected	90% Cellulose	10% Other	Tan, White Fibrous Heterogeneous
1200496PLM_9					Teased
G-10	1x1 ceiling tile - spline	None Detected	90% Cellulose	10% Other	Tan, White Fibrous Heterogeneous
1200496PLM_10					Teased
G-11	Linoleum flooring-yellow	None Detected	30% Cellulose	70% Other	Gray, White, Pink Non Fibrous Heterogeneous
1200496PLM_11					Teased
G-12	Linoleum flooring-yellow	None Detected	30% Cellulose	70% Other	Gray, White, Pink Non Fibrous Heterogeneous
1200496PLM_12					Teased
G-13	Mastic-yellow	None Detected	5% Cellulose	95% Other	Yellow Non Fibrous Heterogeneous
1200496PLM_13					Dissolved
G-14	Mastic-yellow	None Detected	5% Cellulose	95% Other	Yellow Non Fibrous Heterogeneous
1200496PLM_14					Dissolved
G-15	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200496PLM_15					Teased
G-16	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200496PLM_16					Crushed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Byron Stroble (36)

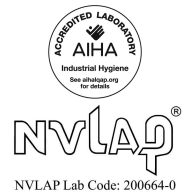
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200496

**Analysis ID:** 1200496\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set G Social Services

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
G-17	Plaster-skim	None Detected	5% Cellulose	50% Other 45% Gypsum	White Non Fibrous Heterogeneous
1200496PLM_17					Teased
G-18	Plaster-base	None Detected	5% Cellulose	80% Other 15% Quartz	Beige Non Fibrous Heterogeneous
1200496PLM_18					Crushed
G-19	Mastic-brown	None Detected	2% Cellulose	98% Other	Brown Non Fibrous Heterogeneous
1200496PLM_19					Dissolved
G-20	Mastic-brown	None Detected	2% Cellulose	98% Other	Brown Non Fibrous Heterogeneous
1200496PLM_20					Dissolved
G-21	Carpet mastic-beige	None Detected	2% Cellulose	98% Other	Beige, Black Non Fibrous Heterogeneous
1200496PLM_21	mixed mastics				Dissolved
G-22	Carpet mastic-beige	None Detected	2% Cellulose	98% Other	Beige, Black Non Fibrous Heterogeneous
1200496PLM_22	mixed mastics				Dissolved
G-23	Covebase mastic-yellow	None Detected		100% Other	Yellow Non Fibrous Heterogeneous
1200496PLM_23					Ashed
G-24	Covebase mastic-yellow	None Detected		100% Other	Yellow Non Fibrous Heterogeneous
1200496PLM_24					Ashed

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Byron Stroble (36)

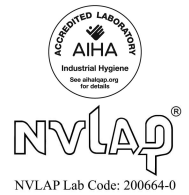
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200496

**Analysis ID:** 1200496\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set G Social Services

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
G-25	12" floor tile-green	None Detected		100% Other	Green Non Fibrous Heterogeneous
1200496PLM_25					Dissolved
G-26	Mastic-black	6% Chrysotile	4% Cellulose	90% Other	Black Non Fibrous Heterogeneous
1200496PLM_26					Dissolved
G-27	12" floor tile-green	None Detected		100% Other	Green Non Fibrous Heterogeneous
1200496PLM_27					Dissolved
G-28	Mastic - black	Not Analyzed			
1200496PLM_28					
G-29	2x4 ceiling tiles-white	None Detected	40% Cellulose 40% Mineral Wool	10% Perlite 10% Other	White, Grayish Fibrous Heterogeneous
1200496PLM_29					Teased
G-30	2x4 ceiling tiles-white	None Detected	40% Cellulose 40% Mineral Wool	10% Perlite 10% Other	White, Grayish Fibrous Heterogeneous
1200496PLM_30					Teased
G-31	2x4 ceiling tile-tan	None Detected	40% Cellulose 40% Mineral Wool	10% Perlite 10% Other	White, Grayish Fibrous Heterogeneous
1200496PLM_31					Teased
G-32	2x4 ceiling tile-tan	None Detected	40% Cellulose 40% Mineral Wool	10% Perlite 10% Other	White, Grayish Fibrous Heterogeneous
1200496PLM_32					Teased

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Byron Stroble (36)

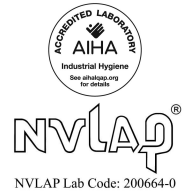
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200496

**Analysis ID:** 1200496\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set G Social Services

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
G-33	Window caulk-brown	None Detected	2% Cellulose	98% Other	White, Black Non Fibrous Heterogeneous
1200496PLM_33					Dissolved
G-34	Window caulk-brown	None Detected	2% Cellulose	98% Other	Black Non Fibrous Heterogeneous
1200496PLM_34					Dissolved
G-35	Covebase-grey	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200496PLM_35					Ashed
G-36	Covebase-grey	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200496PLM_36					Ashed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Byron Stroble (36)

Analyst

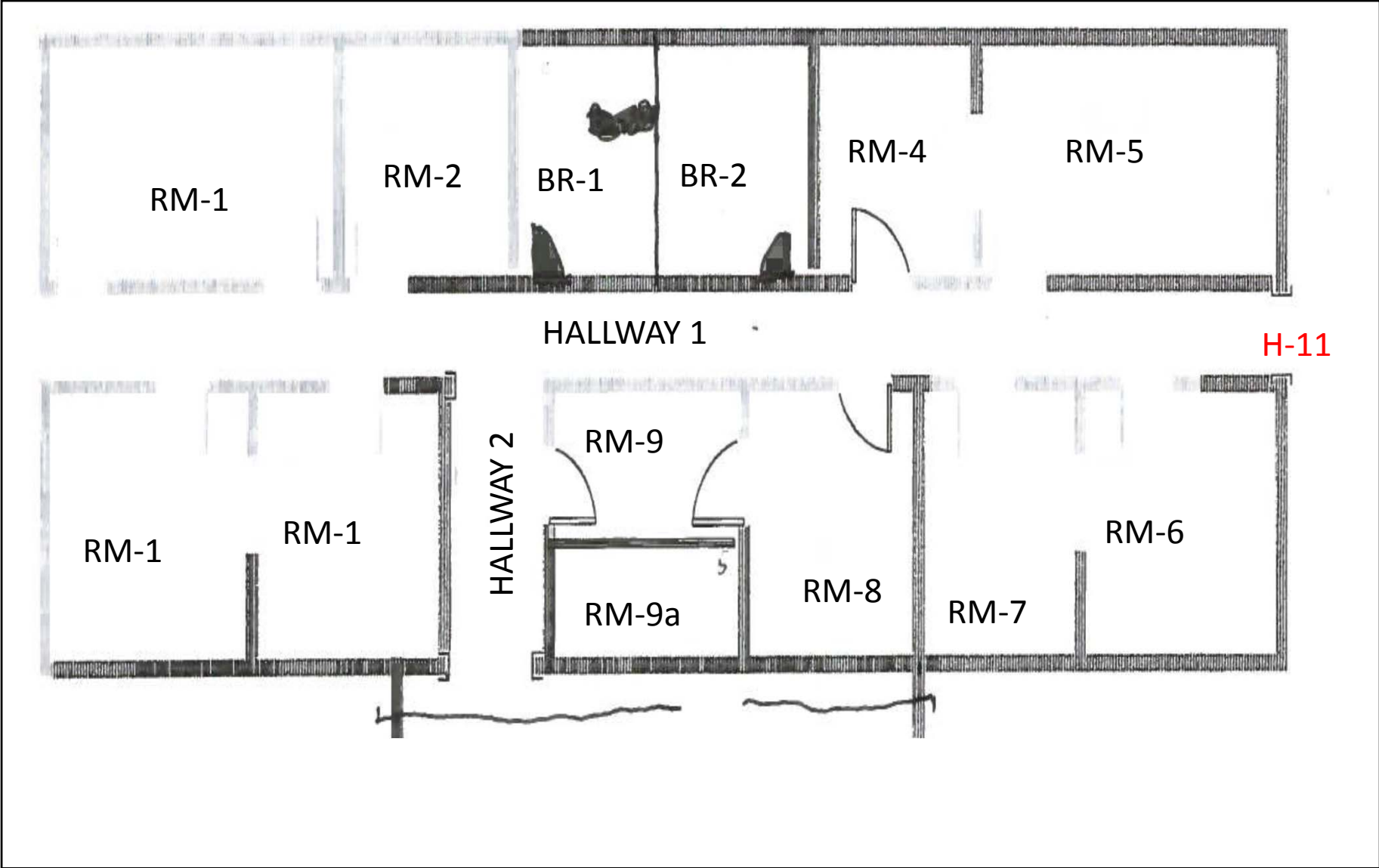
Approved Signatory



### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Y or N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
G-1	drywall	wall a	white	computer room	0.00	no
G-2	wood	door frame	white	computer room	0.00	no
G-3	wood	window sill	white	break room	0.00	no
G-4	drywall	wall a	light gray	near cubicle 6317	0.00	no
G-5	metal	door	brown	near cubicle 6352 exit door	0.00	no
G-6	brick	wall c	white	sprinkler system room	0.30	no
G-7	drywall	ceiling	white	infron of cubicle 6348	0.00	no
G-8	wood	window sill	white	conference room	0.00	no
G-9	wood	baseboard	white	stairway near DNA office	0.00	no
G-10	metal	railing	white	stairway near DNA office	0.02	no
G-11	metal	railing	black	stairway near DNA office	0.10	no
G-12	wood	door	white	stairway near DNA office	0.00	no
G-13	metal	door	black	2nd floor hallway	0.00	no
G-14	drywall	wall c	tan/blue wallpa	room 6361	0.00	no
G-15	drywall	wall a	wallpaper	main lobby	0.00	no
G-16	drywall	wall d	white	main lobby women's bathroom	0.01	no
G-17	concrete	wall b	cream	exterior of building	0.00	no
G-18	metal	door	brown	exterior of side door	0.00	no
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA

**(H) RESOURCE DEVELOPMENT BUILDING**

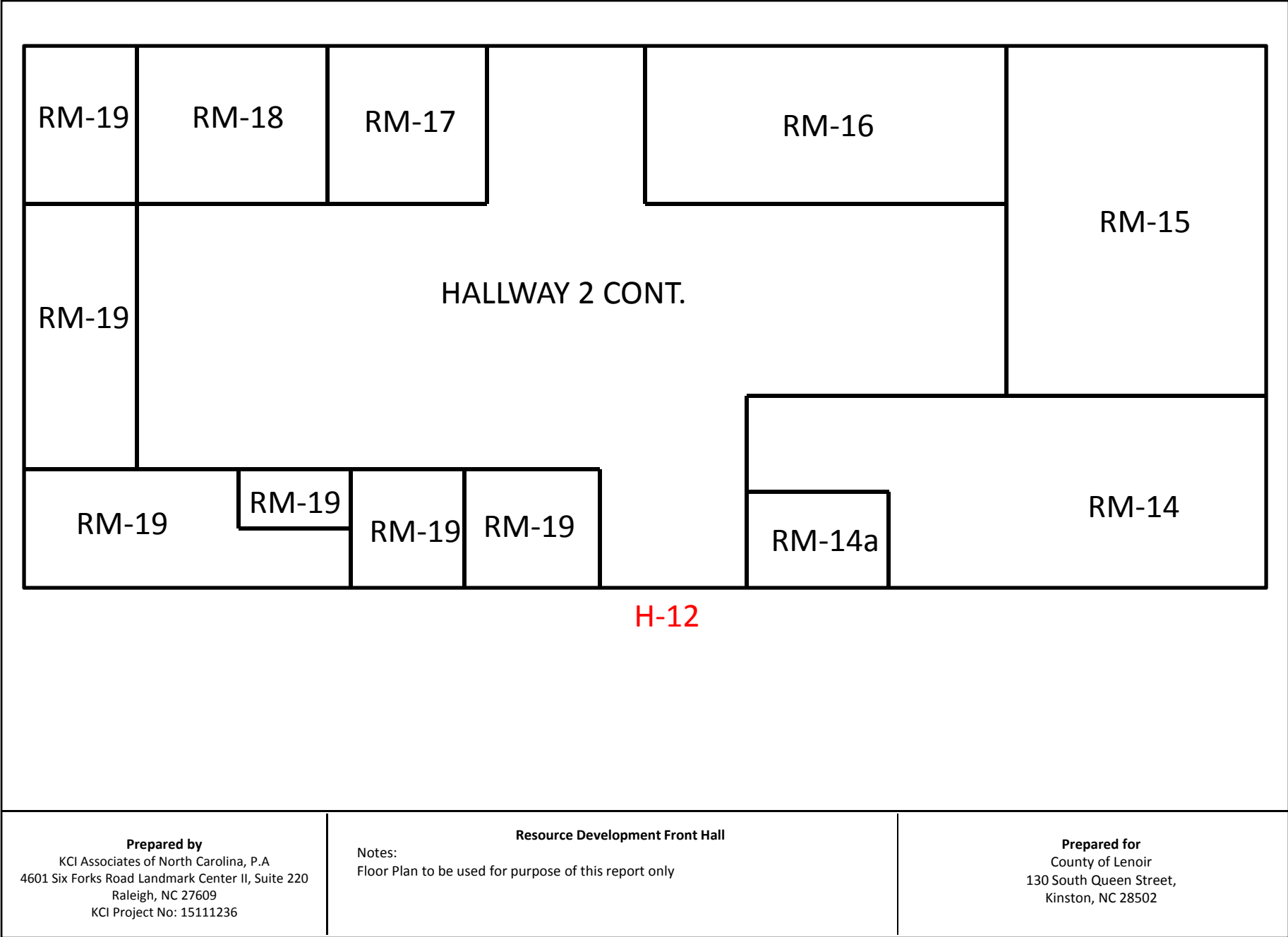


**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Resource Development Back Hall**

Notes:  
 1,250 SF of asbestos-containing floor tile and mastic  
 400 LF of asbestos-containing window caulking on exterior windows  
 60 LF of asbestos-containing door caulking on exterior doors  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



H-12

**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Resource Development Front Hall**  
 Notes:  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200499

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone ☐: 410.891.1726
4601 Six Forks Rd., 220	Fax ☐: 410316.7935
Raleigh, NC 27609	Email ☐: tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number: \_\_\_\_\_  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 10 sets.			
set B	Sample # B-1 to B-23	-	Please apply positive stop as indicated on sampling datasheets.
set C	Sample # C-1 to C-30		
set D	Sample # D-1 to D-6		
set E	Sample # E-1 to E-42		
set F	Sample # F-1 to F-32	-	Please separate layers for Floor Tile and Mastic & Plaster samples.
set G	Sample # G-1 to G-36		
set H	Sample # H-1 to H-48		
set I	Sample # I-1 to I-11		
set J	Sample # J-1 to J-31	-	Please provide separate reports for each set of samples.
set K	Sample # K-1 to K-42.		

Total # of Samples

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/11/2012.	<i>[Signature]</i>	1-12 2:30A

Accepted   
 Rejected

Page \_\_\_ of \_\_\_

1200499



## ASBESTOS BULK SAMPLE SHEET

Job Order No: \_\_\_\_\_

Location: Resource Development (H)Date: 1-10-12Inspector: WILLIAM S. CANESignature: Willa S. CanePage: 1 of 3

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
H-01	12x12 wall tiles	RM 4 white				JPS
H-02	12x12 wall tiles	RM 4 white				J
H-03	12x12 ceiling tile	<del>RM 4</del> Throughout back section of building				JPS
H-04	12x12 ceiling tile					J
H-05	2x4 ceiling tile	Hallway 1				JPS
H-06	2x4 ceiling tile	Hallway 1				J
H-07	Ext metal windows glazing	ext metal <del>metal</del> windows			14 total	JPS
H-08	Ext metal windows glazing	" " "			14 total	J
H-09	window glazing	small metal windows back BR's			2 total	JPS
H-10	window glazing	" "			2 total	J
H-11	Ext Door caulking	Ext Doors				JPS
H-12	Ext Door caulking	Ext Doors				J
H-13	vinyl / mastic	BR 1 c. <del>BR 1</del>				JPS Separate layers
H-14	vinyl / mastic	<del>BR 1</del> c. BR 2				JPS Separate layers
H-15	SR	RM 9a				JPS
H-16	SR	RM 9a				J
H-17	carpet mastic	RM 9a				JPS
H-18	carpet mastic	RM 9a				J

1200499



## ASBESTOS BULK SAMPLE SHEET

Job Order No: \_\_\_\_\_

Location: Resource Development (H)Date: 1-10-12Inspector: CSLSignature: CSLPage: 2 of 3

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
H-19	vinyl floor / underlayment	Rm 14a			382 SF	] PS
H-20	" "	Rm 14a			382 SF	] PS
H-21	Black mastic	Rm 18 (throughout front				] PS
H-22	Black mastic	Rm 18 (Half of Bldg)				] PS
H-23	window glazing	front half metal windows			16 total	] PS
H-24	window glazing	" " "			16 total	] PS
H-25	vinyl floor	Rm 21 under carpet			162 SF	] PS
H-26	vinyl floor	" " "			162 SF	] PS
H-27	SR / JC	Hallway 2				] PS
H-28	SR / JC	Hallway 2				] PS
H-29	2x4 ceiling tile	Hallway 2				] PS
H-30	2x4 ceiling tile	Hallway 2				] PS
H-31	PeroCell	Rear of Boiler #6			1 SF	] PS
H-32	PeroCell	Rear of Boiler #6				] PS
H-33	Hard elbow	2" boiler line + CRAWLSPACE			34	] PS include H-48
H-34	Hard elbow	2" boiler line + CRAWLSPACE				] PS for PS.
H-35	Brown paper	Unit 3 HVAC Basement				] PS
H-36	Brown paper	Unit 3 HVAC Basement				] PS

1200499



ASBESTOS BULK SAMPLE SHEET

Job Order No: \_\_\_\_\_

Location: \_\_\_\_\_

Resource Development (H)

Date: \_\_\_\_\_

1-10-12

Inspector: \_\_\_\_\_

LSC

Signature: \_\_\_\_\_

LSC

Page: \_\_\_\_\_

3 of 3

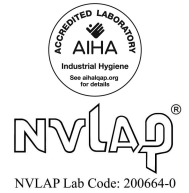
Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
H-37	Aerocell	2" line crawlspace + BASEMENT			280AF	7 PS
A-38	Aerocell	2" line crawlspace + BASEMENT				
H-39	SR / JC	Basement				
H-40	SR / JC	Basement				
<del>H-41</del>	<del>Plaster</del>	<del>throughout FRONT HALF OF BUILDING</del>				
H-41	Plaster	throughout FRONT HALF OF BUILDING				7 PS for all skim and all base.  Separate layers.
H-42						
H-43						
H-44						
H-45						
H-46						
H-47						
H-48	Hard Fibrow	2" Boiler line				





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200499

**Analysis ID:** 1200499\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set H Resource  
Development

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
H-1	12x12 wall tiles	None Detected	85% Fiber Glass 10% Cellulose	5% Other	White Non Fibrous Homogeneous
1200499PLM_1					Teased
H-2	12x12 wall tiles	None Detected	85% Fiber Glass 10% Cellulose	5% Other	White Non Fibrous Homogeneous
1200499PLM_2					Teased
H-3	12x12 ceiling tile	None Detected	95% Cellulose	5% Other	Brown Non Fibrous Homogeneous
1200499PLM_3					Teased
H-4	12x12 ceiling tile	None Detected	95% Cellulose	5% Other	Brown Non Fibrous Homogeneous
1200499PLM_4					Teased
H-5	2x4 ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200499PLM_5					Teased
H-6	2x4 ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200499PLM_6					Teased
H-7	Ext metal windows glazing	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_7					Crushed
H-8	Ext metal windows glazing	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_8					Crushed

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Bart Huber (65)

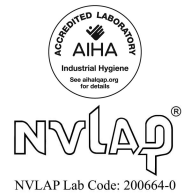
Analyst

Approved Signatory



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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
H-9	Window glazing	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_9					Crushed
H-10	Window glazing	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_10					Crushed
H-11	Ext door caulking	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200499PLM_11					Dissolved
H-12	Ext door caulking	3% Chrysotile		97% Other	Gray Non Fibrous Heterogeneous
1200499PLM_12					Dissolved, Crushed
H-13 - A	Vinyl/mastic	None Detected	15% Cellulose 10% Fiber Glass	75% Other	Brown Non Fibrous Homogeneous
1200499PLM_13	top vinyl				Teased, Dissolved
H-13 - B	Vinyl/mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200499PLM_49	mastic				Dissolved
H-13 - C	Vinyl/mastic	None Detected	15% Cellulose 10% Fiber Glass	75% Other	White Non Fibrous Homogeneous
1200499PLM_50	bottom vinyl				Teased, Dissolved
H-13 - D	Vinyl/mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200499PLM_51	mastic				Dissolved

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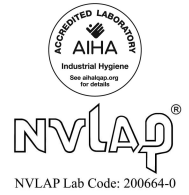
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
H-14 - A	Vinyl/mastic	None Detected	15% Cellulose 10% Fiber Glass	75% Other	Gray Non Fibrous Homogeneous
1200499PLM_14	vinyl				Teased, Dissolved
H-14 - B	Vinyl/mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200499PLM_52	mastic				Dissolved
H-15	SR	None Detected	12% Cellulose	88% Other	White, Brown Non Fibrous Heterogeneous
1200499PLM_15					Crushed
H-16	SR	None Detected	12% Cellulose	88% Other	White, Brown Non Fibrous Heterogeneous
1200499PLM_16					Crushed
H-17	Carpet mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200499PLM_17					Dissolved
H-18	Carpet mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200499PLM_18					Dissolved
H-19 - A	Vinyl floor/underlayment	None Detected	40% Cellulose	60% Other	Tan Non Fibrous Homogeneous
1200499PLM_19	vinyl				Dissolved
H-19 - B	Vinyl floor/underlayment	None Detected		100% Other	Brown Non Fibrous Homogeneous
1200499PLM_53	mastic				Dissolved

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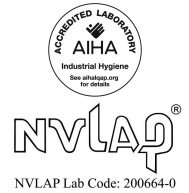
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
H-19 - C	Vinyl floor/underlayment	None Detected	70% Cellulose	30% Other	Black Non Fibrous Homogeneous
1200499PLM_54	felt				Dissolved
H-20 - A	Vinyl floor/underlayment	None Detected	40% Cellulose	60% Other	Tan Non Fibrous Homogeneous
1200499PLM_20	vinyl				Dissolved
H-20 - B	Vinyl floor/underlayment	None Detected		100% Other	Brown Non Fibrous Homogeneous
1200499PLM_55	mastic				Dissolved
H-20 - C	Vinyl floor/underlayment	None Detected	70% Cellulose	30% Other	Black Non Fibrous Homogeneous
1200499PLM_56	felt				Dissolved
H-21	Black mastic	None Detected		100% Other	Black Non Fibrous Homogeneous
1200499PLM_21					Dissolved
H-22	Black mastic	None Detected		100% Other	Black Non Fibrous Homogeneous
1200499PLM_22					Dissolved
H-23	Window glazing	None Detected		100% Other	Tan Non Fibrous Homogeneous
1200499PLM_23					Crushed
H-24	Window glazing	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_24					Crushed

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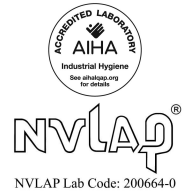
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
H-25 - A	Vinyl floor	<b>None Detected</b>	20% Cellulose 10% Fiber Glass	70% Other	Tan Non Fibrous Homogeneous
1200499PLM_25	vinyl				Teased, Dissolved
H-25 - B	Vinyl floor	<b>None Detected</b>		100% Other	Yellow Non Fibrous Homogeneous
1200499PLM_57	mastic				Dissolved
H-26 - A	Vinyl floor	<b>None Detected</b>	20% Cellulose 10% Fiber Glass	70% Other	Tan Non Fibrous Homogeneous
1200499PLM_26	vinyl				Teased, Dissolved
H-26 - B	Vinyl floor	<b>None Detected</b>		100% Other	Yellow Non Fibrous Homogeneous
1200499PLM_58	mastic				Dissolved
H-27	SR/JC	< 1% <b>Chrysotile</b>	12% Cellulose	88% Other	White, Brown, Tan Non Fibrous Heterogeneous
1200499PLM_27	sheetrock: none detect; joint compnd: 3% chrysotile				Crushed
H-28	SR/JC	< 1% <b>Chrysotile</b>	12% Cellulose	88% Other	White, Brown, Tan Non Fibrous Heterogeneous
1200499PLM_28	sheetrock: none detect; joint compnd: 3% chrysotile				Crushed
H-29	2x4 ceiling tile	<b>None Detected</b>	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200499PLM_29					Teased
H-30	2x4 ceiling tile	<b>None Detected</b>	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200499PLM_30					Teased

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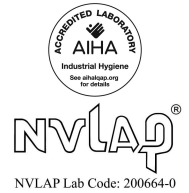
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
H-31	Aerocell	60% Chrysotile	20% Cellulose	20% Other	White Non Fibrous Homogeneous
1200499PLM_31					Teased
H-32	Aerocell	Not Analyzed			
1200499PLM_32					
H-33	Hard elbow	15% Chrysotile		85% Other	Gray Non Fibrous Homogeneous
1200499PLM_33					Crushed
H-34	Hard elbow	Not Analyzed			
1200499PLM_34					
H-35	Brown paper	None Detected	70% Cellulose	30% Other	Black, Brown Non Fibrous Homogeneous
1200499PLM_35					Dissolved
H-36	Brown paper	None Detected	70% Cellulose	30% Other	Black, Brown Non Fibrous Homogeneous
1200499PLM_36					Dissolved
H-37	Aerocell	10% Chrysotile	20% Cellulose	70% Other	White Non Fibrous Homogeneous
1200499PLM_37					Crushed
H-38	Aerocell	Not Analyzed			
1200499PLM_38					

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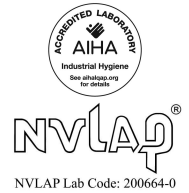
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Lab Sample ID	Lab Notes				Treatment
H-39	SR/JC	None Detected	12% Cellulose	88% Other	White, Brown Non Fibrous Heterogeneous
1200499PLM_39	sheetrock: none detect; joint compnd: none detect				Crushed
H-40	SR/JC	None Detected	12% Cellulose	88% Other	White, Brown Non Fibrous Heterogeneous
1200499PLM_40	sheetrock: none detect; joint compnd: none detect				Crushed
H-41 - A	Plaster	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_41	finish				Crushed
H-41 - B	Plaster	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200499PLM_59	base				Crushed
H-42 - A	Plaster	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_42	finish				Crushed
H-42 - B	Plaster	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200499PLM_60	base				Crushed
H-43 - A	Plaster	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_43	finish				Crushed
H-43 - B	Plaster	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200499PLM_61	base				Crushed

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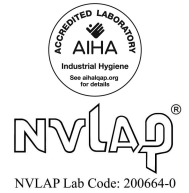
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Lab Sample ID	Lab Notes				Treatment
H-44 - A	Plaster	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_44	finish				Crushed
H-44 - B	Plaster	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200499PLM_62	base				Crushed
H-45 - A	Plaster	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_45	finish				Crushed
H-45 - B	Plaster	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200499PLM_63	base				Crushed
H-46 - A	Plaster	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_46	finish				Crushed
H-46 - B	Plaster	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200499PLM_64	base				Crushed
H-47 - A	Plaster	None Detected		100% Other	White Non Fibrous Homogeneous
1200499PLM_47	finish				Crushed
H-47 - B	Plaster	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200499PLM_65	base				Crushed

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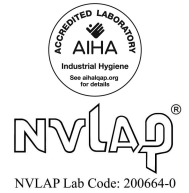
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
H-48	Hard elbow	Not Analyzed			
1200499PLM_48					

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Analyst

Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
H-4	concrete	wall	white	back hallway	0.40	no
H-5	metal	door frame	white	in front of room 1	0.08	no
H-6	metal	door	white	in front of room 1	0.08	no
H-7	metal	base board	white	in front of room 1	0.25	no
H-8	wood	wall	cream	inside of room 1	0.03	no
H-9	metal	window sill	white	room 4	0.00	no
H-10	metal	window	white	room 4	0.02	no
H-11	concrete	window sill	white	room 6	0.14	no
H-12	drywall	wall	cream	men's bathroom	0.14	no
H-13	wood	door	light green	room 9a	0.04	no
H-14	wood	door frame	light green	room 9a	0.04	no
H-15	drywall	wall	cream	room 14, front half	0.03	no
H-16	wood	door	white	room 21 near vault	0.21	no
H-17	concrete	wall	cream	room 21 near vault	0.02	no
H-18	wood	shutters	black	exterior of conference room	0.00	no
H-19	wood	chair rail	white	hallway 2 next to exit	0.00	no
H-20	metal	railing	black	exterior of back half	0.00	no
H-21	metal	door	gray	basement	0.00	no
H-22	metal	pipng	black	basement	0.00	no
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
Cal4		SRM - 2579	Red	Calibration Test	1.00	NA
Cal5		SRM - 2579	Red	Calibration Test	1.00	NA





Resource Development Building with assumed asbestos containing roof shingles and window caulking



Asbestos containing door Caulking



Assumed asbestos containing floor tile and mastic

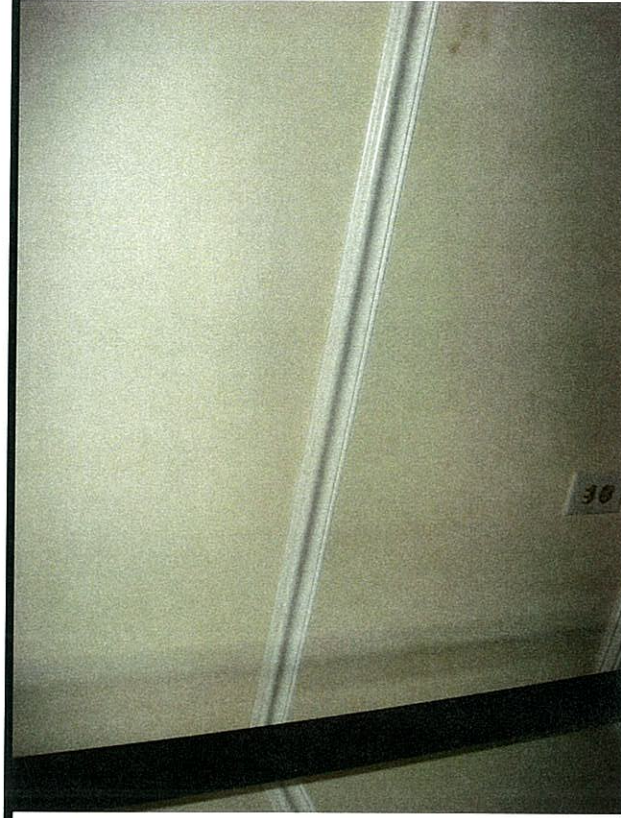


Asbestos Containing hard elbows on 2inch boiler lines



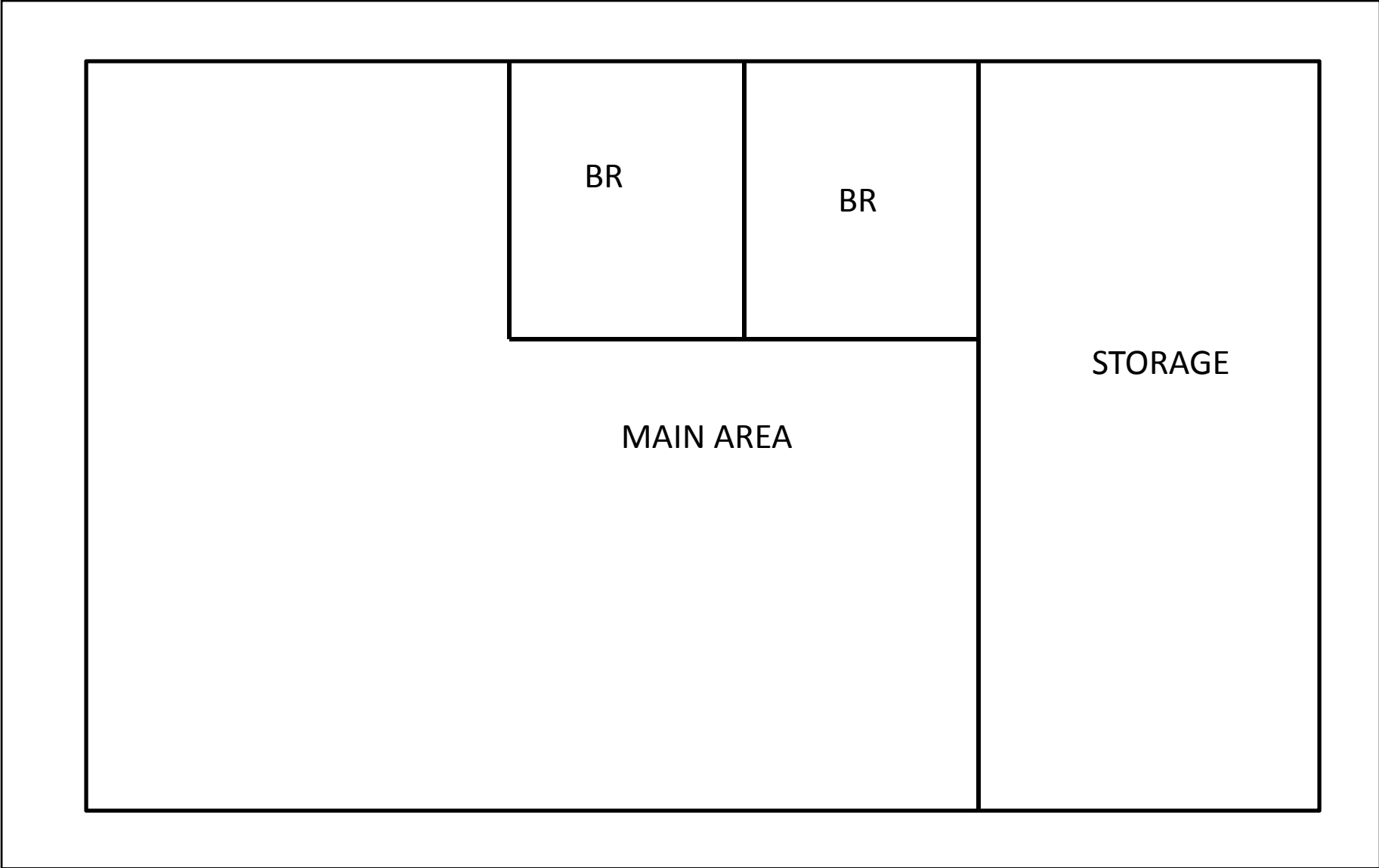


Asbestos containing Aircell pipe insulation on 2inch boiler lines throughout basement and crawl space



< 1 % Sheetrock/Joint compound located throughout

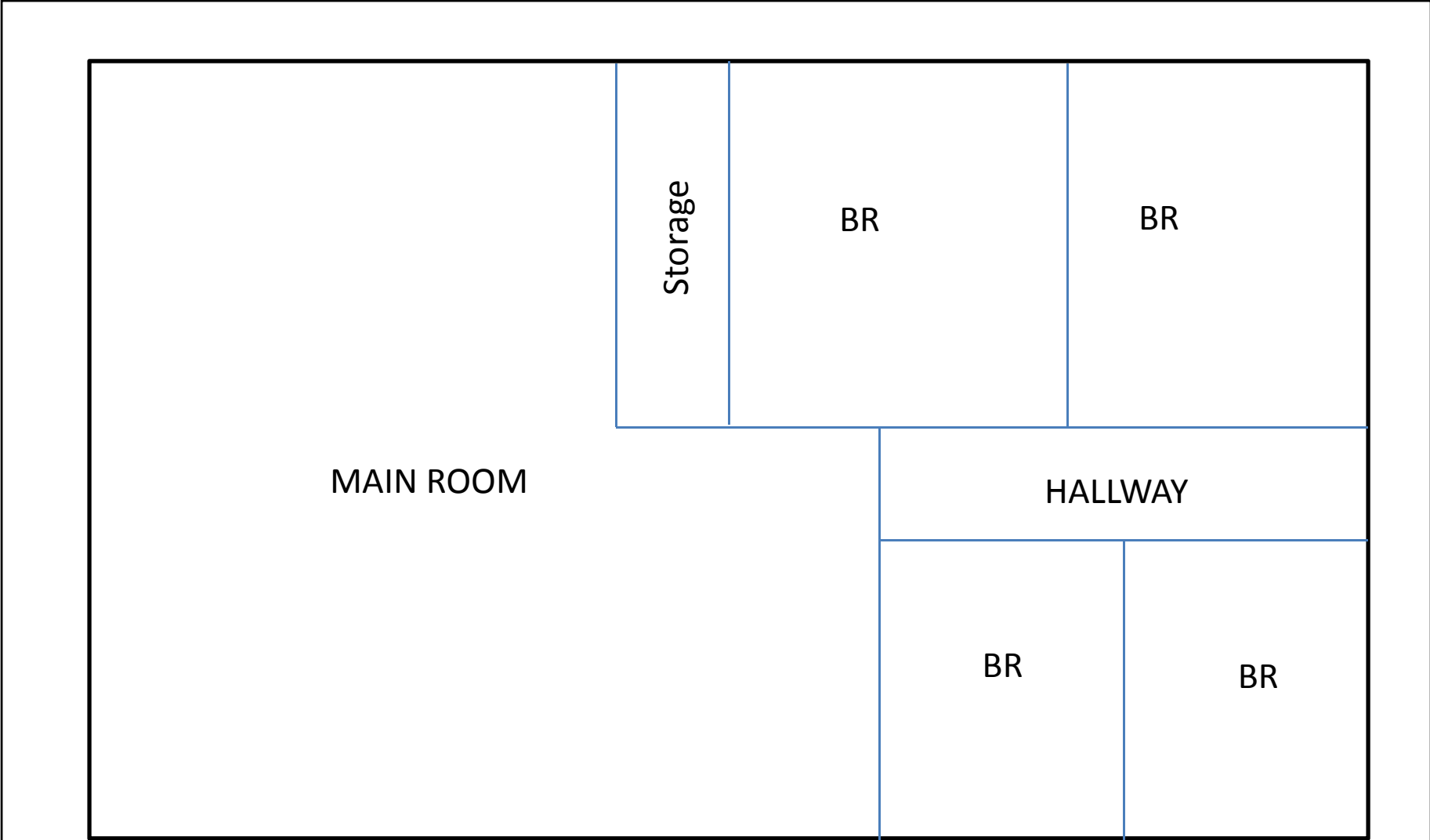
**(I) NATURE CENTER AND EDUCATION BUILDING**



**Prepared by**  
KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

**Nature Center Building One**  
**Notes:**  
Floor Plan to be used for purpose of this report only

**Prepared for**  
County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502



**Prepared by**  
KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

**Nature Center Building One**  
**Notes:**  
Floor Plan to be used for purpose of this report only

**Prepared for**  
County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200498

Lab Use Only
Lab Order ID: _____
Client Code: _____

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone [ ]: 410.891.1726
4601 Six Forks Rd., 220	Fax [ ]: 410316.7935
Raleigh, NC 27609	Email [ ]: tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number:
Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 10 sets.			
set B	Sample # B-1 to B-23		- Please apply positive stop as indicated on sampling datasheets.
set C	Sample # C-1 to C-30		
set D	Sample # D-1 to D-6		
set E	Sample # E-1 to E-42		
set F	Sample # F-1 to F-32		
set G	Sample # G-1 to G-36		- Please separate layers for Floor Tile and Mastic & Plaster samples.
set H	Sample # H-1 to H-48		
set I	Sample # I-1 to I-11		
set J	Sample # J-1 to J-31		- Please provide separate reports for each set of samples.
set K	Sample # K-1 to K-42.		

Total # of Samples

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/11/2012.		1-12 9:30A

Accepted   
 Rejected

Page \_\_\_ of \_\_\_







# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200498

**Analysis ID:** 1200498PLM

**Date Received:** 1/12/2012

**Date Reported:** 1/18/2012

**Date Amended:** 1/31/2012

**Project:** 15111236 IHG-00 Set I Nature Center  
Building 1

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
I-1	SR/JC	None Detected	12% Cellulose	88% Other	Brown, White Non Fibrous Heterogeneous
1200498PLM_1	sheetrock: none detect; joint compnd: none detect				Crushed
I-2	SR/JC	None Detected	12% Cellulose	88% Other	Brown, White Non Fibrous Heterogeneous
1200498PLM_2	sheetrock: none detect; joint compnd: none detect				Crushed
I-3	Ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200498PLM_3			Teased		
I-4	Ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200498PLM_4			Teased		
I-5	Ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200498PLM_5			Teased		
I-6	Ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200498PLM_6			Teased		
I-7	Stucco	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200498PLM_7			Crushed		
I-8	Stucco	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200498PLM_8			Crushed		

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Bart Huber (19)

Analyst

Nathaniel Durham, MS or Approved Signatory

# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200498

**Analysis ID:** 1200498PLM

**Date Received:** 1/12/2012

**Date Reported:** 1/18/2012

**Date Amended:** 1/31/2012

**Project:** 15111236 IHG-00 Set I Nature Center  
Building 1

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
I-9	Stucco	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200498PLM_9					Crushed
I-10	Stucco	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200498PLM_10					Crushed
I-11	Stucco	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200498PLM_11					Crushed
I-12	Ceiling tile tan 2x2	None Detected	95% Fiber Glass	5% Other	White Non Fibrous Homogeneous
1200498PLM_12					Teased
I-13	Ceiling tile tan 2x2	None Detected	95% Fiber Glass	5% Other	White Non Fibrous Homogeneous
1200498PLM_13					Teased
I-14	Ceiling tile textured	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200498PLM_14			Teased		
I-15	Ceiling tile textured	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200498PLM_15			Teased		
I-16	Ceiling tile wormhole	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200498PLM_16			Teased		

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Bart Huber (19)

Analyst

Nathaniel Durham, MS or Approved Signatory

# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200498

**Analysis ID:** 1200498PLM

**Date Received:** 1/12/2012

**Date Reported:** 1/18/2012

**Date Amended:** 1/31/2012

**Project:** 15111236 IHG-00 Set I Nature Center  
Building 1

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
I-17	Ceiling tile wormhole	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200498PLM_17					Teased
I-18	SR/JC	None Detected	12% Cellulose 3% Fiber Glass	85% Other	Brown, White Non Fibrous Heterogeneous
1200498PLM_18	sheetrock: none detect; joint compnd: none detect not on				Crushed
I-19	SR/JC	None Detected	12% Cellulose 3% Fiber Glass	85% Other	Brown, White Non Fibrous Heterogeneous
1200498PLM_19	sheetrock: none detect; joint compnd: none detect not on				Crushed

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Bart Huber (19)

Analyst

Nathaniel Durham, MS or Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
I-1	metal	door	greenish blue	main entrance door	0.00	no
I-2	metal	door frame	greenish blue	main entrance door	0.00	no
I-3	drywall	wall	gray	main lobby	0.00	no
I-4	drywall	wall	greenish blue	main lobby	0.00	no
I-5	drywall	wall c	white	bathroom	0.00	no
I-6	concrete	wall	white	exterior of back door	0.00	no
I-7	metal	door	green	exterior of back door	0.00	no
I-8	metal	door frame	green	exterior of back door	0.00	no
I-9	wood	door	gray	basement feeding center	0.00	no
I-10	drywall	wall b	green	main lobby of education center	0.00	no
I-11	metal	door frame	yellow	main lobby of education center	0.01	no
I-12	metal	door frame	tan	main lobby of education center	0.00	no
I-13	wood	border	pink	main lobby of education center	0.00	no
I-14	drywall	wall	pink	main lobby closet	0.00	no
I-15	drywall	wall	yellow	boys bathroom	0.00	no
I-16	concrete	wall	yellow	girls bathroom	0.00	no
I-17	concrete	wall	gray	girls bathroom	0.00	no
I-18	concrete	wall	tan	exterior of building	0.00	no
I-19	metal	cage	black	exterior of building	0.00	no
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
Cal4		SRM - 2579	Red	Calibration Test	1.00	NA
Cal5		SRM - 2579	Red	Calibration Test	1.00	NA



Nature Center Building with assumed Asbestos Containing Built up tar roofing and Assumed Asbestos containing Vibration Dampers



Education Building with Assumed Asbestos Containing Paint coating on metal seamed roof

## **(J) PLANETARIUM**





**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200513

**Lab Use Only**  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

**Company Contact Information**

Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone <input type="checkbox"/> : 410.891.1726
4601 Six Forks Rd., 220	Fax <input type="checkbox"/> : 410316.7935
Raleigh, NC 27609	Email <input type="checkbox"/> : tehsin@kci.com

**Asbestos Test Types**

PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

<b>Billing/Invoice Information</b>	<b>Turn Around Times</b>	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number: \_\_\_\_\_  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 10 sets.			
set B	Sample # B-1 to B-23		- Please apply positive stop as indicated on sampling datasheets.
set C	Sample # C-1 to C-30		
set D	Sample # D-1 to D-6		
set E	Sample # E-1 to E-42		
set F	Sample # F-1 to F-32		- Please separate layers for Floor Tile and Mastic & Plaster samples.
set G	Sample # G-1 to G-36		
set H	Sample # H-1 to H-48		
set I	Sample # I-1 to I-11		- Please provide separate reports for each set of samples.
set J	Sample # J-1 to J-31		
set K	Sample # K-1 to K-42.		

Total # of Samples

<b>Relinquished by</b>	<b>Date/Time</b>	<b>Received by</b>	<b>Date/Time</b>
Tehsin Aurangabadwala	1/11/2012.		1-12 9:30A

Accepted   
 Rejected

1200513



## ASBESTOS BULK SAMPLE SHEET

Job Order No: \_\_\_\_\_

Location: \_\_\_\_\_

Planetarium

Date: 1-9-12

Inspector: WILLIAM S. LANE

Signature: *William S. Lane*

Page: 1 of 2

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good / Damaged		
J-01	Ceiling tile 2x2	1 <sup>st</sup> floor Boy's BR <sup>grey/worm/dot</sup>				
J-02	Ceiling tile 2x2	1 <sup>st</sup> floor Boy's BR <sup>white/worm/dot</sup>				
J-03	Ceiling tile 2x2	1 <sup>st</sup> floor Office stucko tile			192'	} PS.
J-04	Ceiling tile 2x2	1 <sup>st</sup> floor Office stucko tile				
J-05	FT / mastic 12x12	1 <sup>st</sup> floor Office orange				} PS. Separate layers
J-06	FT / mastic 12x12	1 <sup>st</sup> floor Office orange				
J-07	spray on ceiling	1 <sup>st</sup> floor			1944'	} PS
J-08					1944'	
J-09						
J-10						
J-11						
J-12	SR / JC	1 <sup>st</sup> floor				} PS - one
J-13	SR / JC	1 <sup>st</sup> floor				} composite Sample
J-14	Cove Base mastic	throughout Building				} PS. Separate layers
J-15	Cove Base mastic	" "				
J-16	Planetarium Screen	Planetarium Ceiling				} PS
J-17	Planetarium Screen	Planetarium Ceiling				} PS

1200513

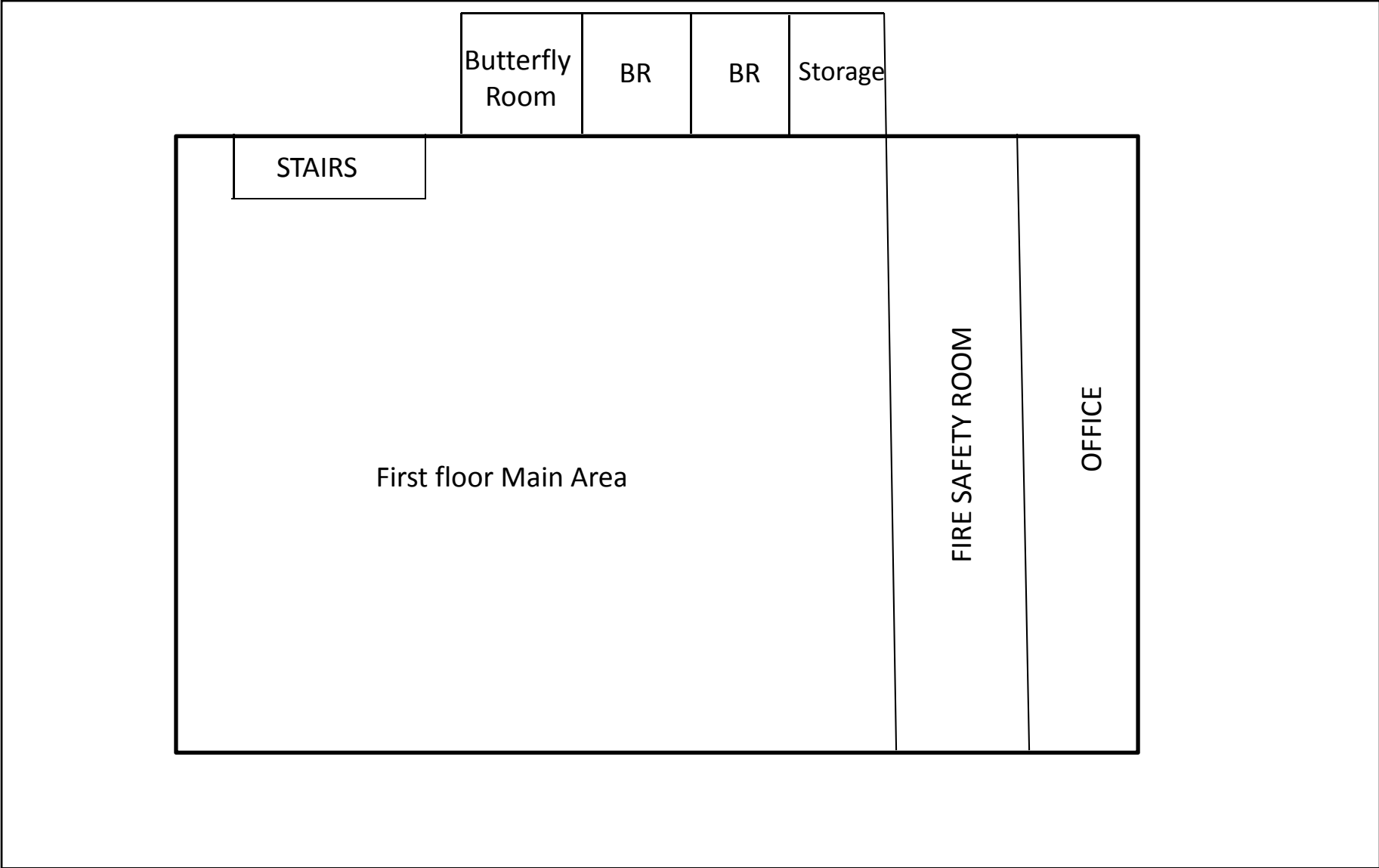


ASBESTOS BULK SAMPLE SHEET

Job Order No: \_\_\_\_\_ Location: Planetarium Date: 1-9-12

Inspector: WGC Signature: WGC Page: 2 of 2

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
J-18	Plaster / <sup>base &amp;</sup> skimcoat	Basement windows				} Positive Stop-all skin and all base. include J-30 & J-3 for PS.
J-19	Plaster / <sup>base &amp;</sup> skimcoat	Basement windows				
J-20	Possible TSI Debris	Basement Ground				} PS
J-21	Possible TSI Debris	Basement Ground				} PS
J-22	Possible transite	Basement windows				} PS
J-23	Possible transite	Basement windows				} PS
J-24	caulking Ext	Doors only				} PS
J-25	caulking Ext	Doors only				} PS
J-26	caulking (old window)	windows only				} PS
J-27	caulking (old window)	windows only				} PS
J-28	stair-tread	1st floor 2nd Floor stairs				} PS
J-29	stair-tread	1st floor 2nd floor stairs				} PS
J-30	Plaster skim	basement windows				include for PS
J-31	Plaster base	basement windows				

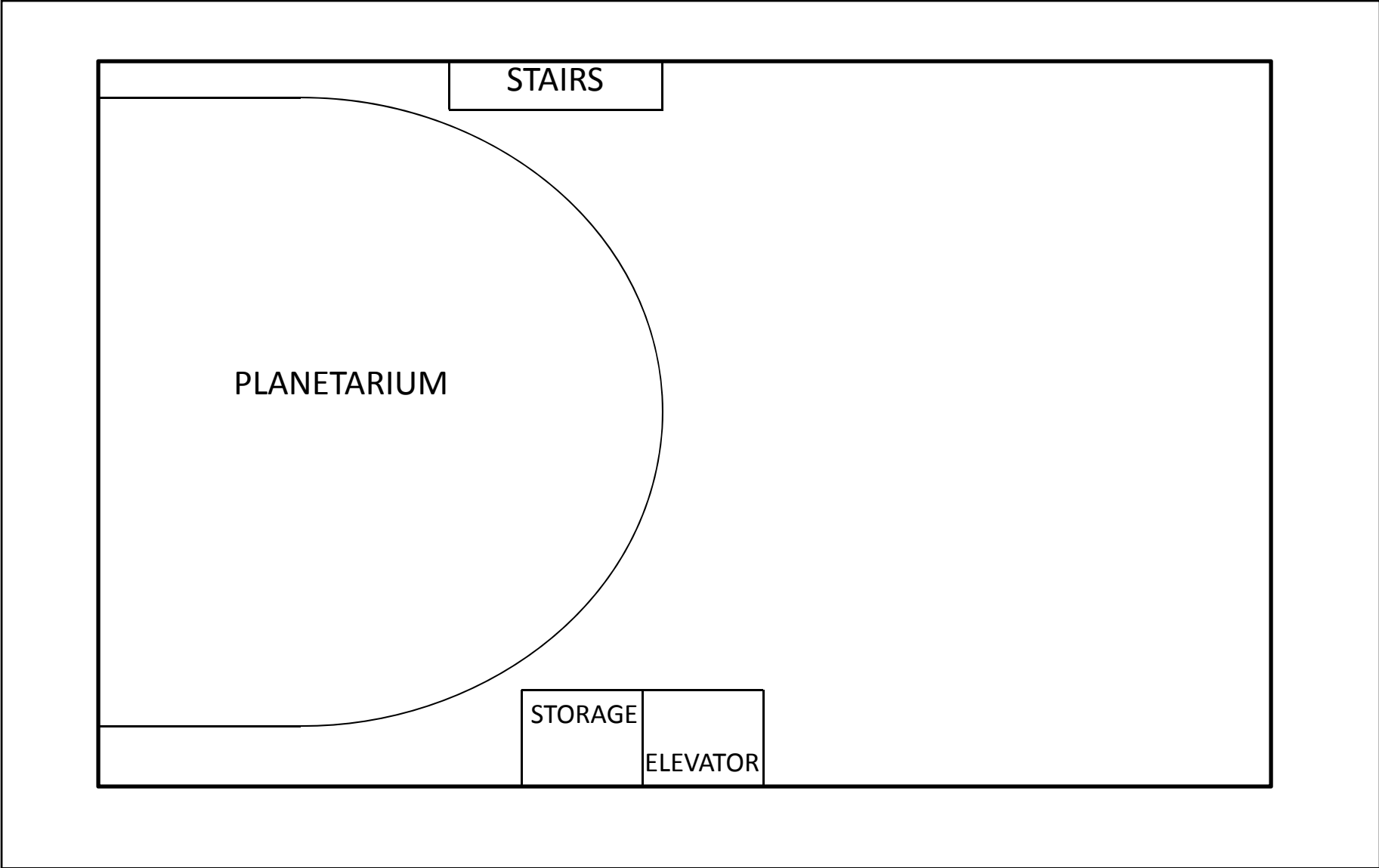


**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Planetarium 1<sup>st</sup> Floor**

Notes:  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Prepared by**  
KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

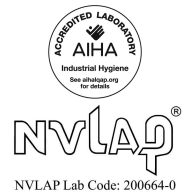
**Planetarium 2nd Floor**  
**Notes:**  
Floor Plan to be used for purpose of this report only

**Prepared for**  
County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200513

**Analysis ID:** 1200513\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set J Planetarium

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
J-1	Ceiling tile 2x2	None Detected	50% Cellulose 30% Mineral Wool	10% Perlite 10% Other	Gray, White Fibrous Heterogeneous
1200513PLM_1					Teased
J-2	Ceiling tile 2x2	None Detected	50% Cellulose 30% Mineral Wool	10% Perlite 10% Other	Gray, White Fibrous Heterogeneous
1200513PLM_2					Teased
J-3	Ceiling tile 2x2	None Detected	90% Mineral Wool	10% Other	White Fibrous Heterogeneous
1200513PLM_3					Teased
J-4	Ceiling tile 2x2	None Detected	90% Mineral Wool	10% Other	White Fibrous Heterogeneous
1200513PLM_4					Teased
J-5 - A	FT/mastic 12x12	None Detected		100% Other	Orange Non Fibrous Heterogeneous
1200513PLM_5	tile				Dissolved
J-5 - B	FT/mastic 12x12	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200513PLM_32	mastic-small sample				Dissolved
J-6 - A	FT/mastic 12x12	None Detected		100% Other	Orange Non Fibrous Heterogeneous
1200513PLM_6	tile				Dissolved
J-6 - B	FT/mastic 12x12	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200513PLM_33	mastic-small sample				Dissolved

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Sharon Donald (37)

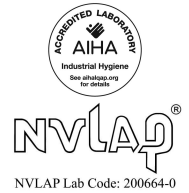
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



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4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200513

**Analysis ID:** 1200513\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set J Planetarium

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
J-7	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200513PLM_7					Crushed
J-8	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200513PLM_8					Crushed
J-9	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200513PLM_9					Crushed
J-10	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200513PLM_10					Crushed
J-11	Spray-on ceiling	None Detected		80% Other 20% Vermiculite	White Non Fibrous Heterogeneous
1200513PLM_11					Crushed
J-12	SR/JC	None Detected	15% Cellulose	55% Gypsum 30% Other	Brown, White, Yellow Fibrous
1200513PLM_12	sheetrock: none detect; joint compnd: none detect				Crushed
J-13	SR/JC	None Detected	15% Cellulose	55% Gypsum 30% Other	Brown, White, Yellow Fibrous
1200513PLM_13	sheetrock: none detect; joint compnd: none detect				Crushed
J-14 - A	Cove base/mastic	None Detected		100% Other	Black Non Fibrous Homogeneous
1200513PLM_14	cove base				Ashed

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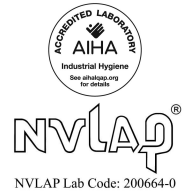
Analyst

Approved Signatory



# Bulk Asbestos Analysis

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EPA Method: 600/R-93/116 and 600/M4-82-020



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**Lab Order ID:** 1200513

**Analysis ID:** 1200513\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set J Planetarium

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
J-14 - B	Cove base/mastic	None Detected		100% Other	Transparent Non Fibrous Homogeneous
1200513PLM_34	mastic				Dissolved
J-15 - A	Cove base/mastic	None Detected		100% Other	Black Non Fibrous Homogeneous
1200513PLM_15	cove base				Ashed
J-15 - B	Cove base/mastic	None Detected		100% Other	Transparent Non Fibrous Homogeneous
1200513PLM_35	mastic				Dissolved
J-16	Planetarium screen	None Detected		100% Other	White Non Fibrous Heterogeneous
1200513PLM_16					Dissolved
J-17	Planetarium screen	None Detected		100% Other	White Non Fibrous Heterogeneous
1200513PLM_17					Dissolved
J-18 - A	Plaster/base & skimcoat	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200513PLM_18	base				Crushed
J-18 - B	Plaster/base & skimcoat	None Detected		100% Other	White Non Fibrous Heterogeneous
1200513PLM_36	skim coat				Crushed
J-19 - A	Plaster/base & skimcoat	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200513PLM_19	base				Crushed

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Sharon Donald (37)

Analyst

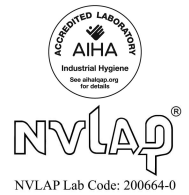
Approved Signatory





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200513

**Analysis ID:** 1200513\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set J Planetarium

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
J-19 - B	Plaster/base & skimcoat	None Detected		100% Other	White Non Fibrous Heterogeneous
1200513PLM_37	skim coat				Crushed
J-20	Possible TSI debris	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200513PLM_20					Crushed
J-21	Possible TSI debris	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200513PLM_21					Crushed
J-22	Possible transite	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200513PLM_22					Crushed
J-23	Possible transite	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200513PLM_23					Crushed
J-24	Caulking ext	None Detected		100% Other	White Non Fibrous Homogeneous
1200513PLM_24					Ashed
J-25	Caulking ext	None Detected		100% Other	White Non Fibrous Homogeneous
1200513PLM_25					Ashed
J-26	Caulking (old window)	None Detected		100% Other	White, Red Non Fibrous Heterogeneous
1200513PLM_26					Crushed

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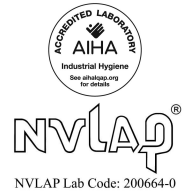
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



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4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200513

**Analysis ID:** 1200513\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set J Planetarium

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
J-27	Caulking (old window)	None Detected		100% Other	White, Red Non Fibrous Heterogeneous
1200513PLM_27					Crushed
J-28	Stair tread	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200513PLM_28					Ashed
J-29	Stair tread	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200513PLM_29					Ashed
J-30	Plaster skim	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200513PLM_30					Crushed
J-31	Plaster base	None Detected		100% Other	Gray Non Fibrous Heterogeneous
1200513PLM_31					Crushed

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Analyst

Approved Signatory

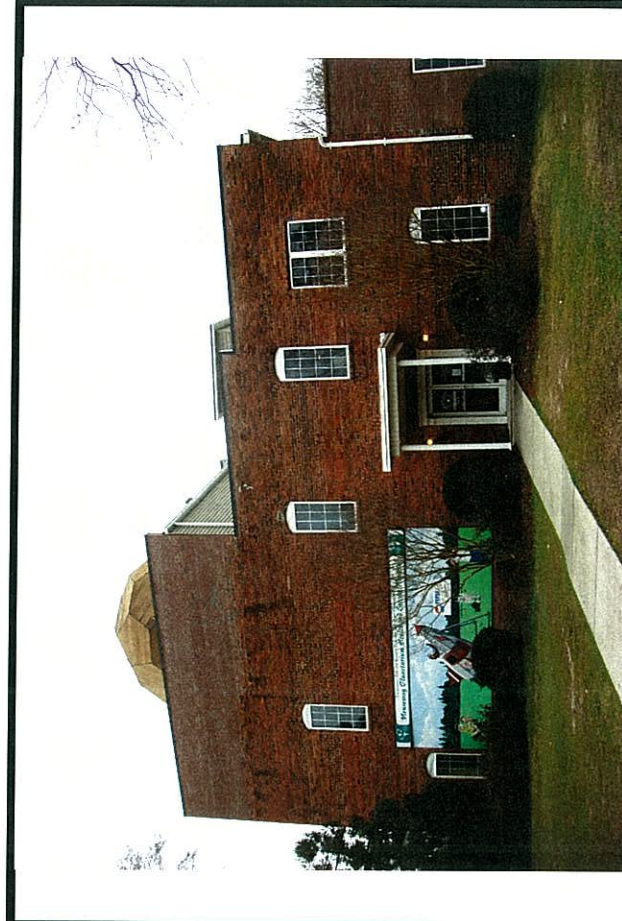
### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
J-1	wood	wall a	yellow	main entrance	0.00	no
J-2	wood	window	white	main entrance	0.01	no
J-3	drywall	wall	blue	inside of handicapped elevator	0.01	no
J-4	drywall	wall	green	in front of handicapped elevator	0.00	no
J-5	wood	window sill	yellow	fire and safety room	0.00	no
J-6	wood	window sill	bluish green	office behind fire and safety room	0.00	no
J-7	wood	wall d	yellow	boys bathroom	0.00	no
J-8	wood	base board	yellow	girls bathroom	0.00	no
J-9	concrete	wall	purple	butterfly room	0.00	no
J-10	wood	wall	green	butterfly room	0.00	no
J-11	wood	door	dark blue	in front of butterfly room	0.00	no
J-12	wood	wall	light blue	play house, main lobby	0.00	no
J-13	wood	wall	white	play house, main lobby	0.01	no
J-14	metal	stair casing	blue	main level	0.00	no
J-15	metal	door	blue	2nd fl back door	0.00	no
J-16	metal	door	brown	exterior of 2nd floor back door	0.00	no
J-17	wood	window sill	blue	2nd fl main lobby	0.00	no
J-18	metal	door frame	black	inside of planetarium	0.00	no
J-19	wood	ceiling	black	inside of planetarium	0.00	no
J-20	metal	pole	white	exterior of building	0.00	no
J-21	wood	wall	red	shed next to planetarium	0.00	no
J-22	metal	pole	black	basement under planetarium	0.00	no
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
Cal4		SRM - 2579	Red	Calibration Test	1.00	NA
Cal5		SRM - 2579	Red	Calibration Test	1.00	NA





Planetarium at Neuseway Park



Assumed ACM Roofing material on Entire Building



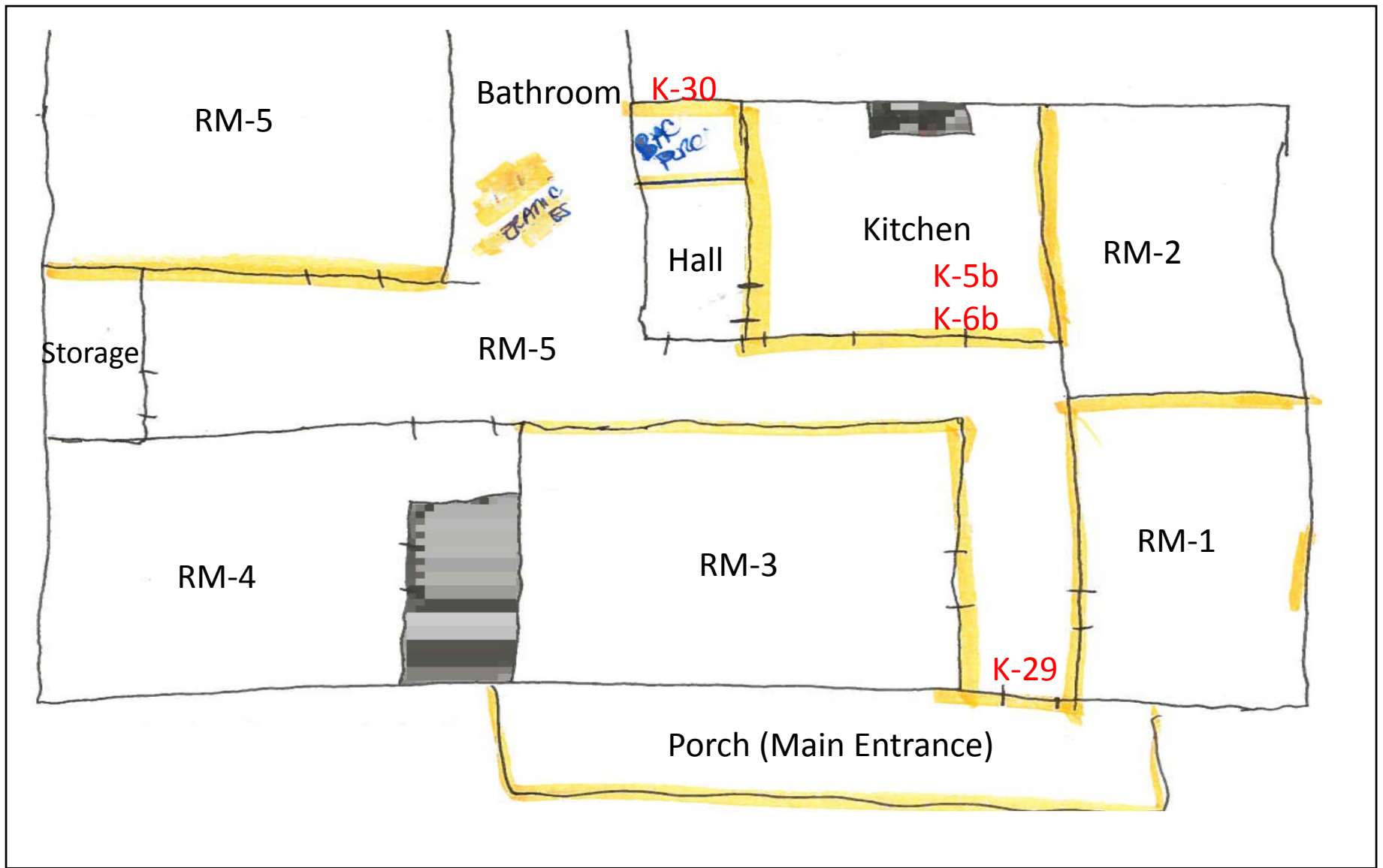
First Floor Non Asbestos Surfacing Material Samples J-07 to J-11



Planetarium Screen No Asbestos Detected

**(K) OLD M.I.S. BUILDING**





**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Old M.I.S. Building**

Notes:  
 Yellow highlight indicates positive lead based paint  
 270 SF of asbestos-containing floor tile mastic  
 400 LF of asbestos containing pipe insulation and wrap  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Old M.I.S. Basement**

Notes:  
 400 LF of asbestos containing pipe insulation and wrap  
 100 SF of asbestos-containing boiler insulation  
 45 SF of elbow insulation  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200500

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone: 410.891.1726
4601 Six Forks Rd., 220	Fax: 410316.7935
Raleigh, NC 27609	Email: tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY TAT.

PO Number:
Project Name/Number: 1511236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 10 sets.			
set B	Sample # B-1 to B-23		- Please apply positive stop as indicated on sampling datasheets.
set C	Sample # C-1 to C-30		
set D	Sample # D-1 to D-6		
set E	Sample # E-1 to E-42		- Please separate layers for Floor Tile and Mastic & Plaster samples.
set F	Sample # F-1 to F-32		
set G	Sample # G-1 to G-36		
set H	Sample # H-1 to H-48		- Please provide separate reports for each set of samples.
set I	Sample # I-1 to I-11		
set J	Sample # J-1 to J-31		
set K	Sample # K-1 to K-42		

Total # of Samples \_\_\_\_\_

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/11/2012		1-12 9:30A

Accepted   
 Rejected



1200500



## ASBESTOS BULK SAMPLE SHEET

Job Order No: \_\_\_\_\_ Location: Old MIS Building Date: 1-9-12Inspector: WILLIAM S. LARIE Signature: William S. Larie Page: 1 of 3

Sample No	Type of Material	Location / Description	Friable		Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged			
K-01	Plaster / <sup>BASE</sup> SKIMCOAT	throughout					} Separate layers
K-02	Plaster / SKIMCOAT	throughout					
K-03	vinyl floor layer 1	Kitchen Floor (vinyl is on countertops)				270 SF	} ps
K-04	vinyl floor layer 1	Kitchen Floor					
K-05	Ft/mastic layer 2	white tile Kitchen Floor				270 SF	} ps Separate layers.
K-06	Ft/mastic layer 2	Black tile Kitchen Floor					
K-07	trailed texture	Basement stairwell and walls					} ps
K-08	trailed texture	" "					
K-09	Hot water line wrap TSI	Hot water line Basement				400 LF	} ps
K-10	" "	" "					
K-11	Aero cell TSI	Hot water pipe Basement + CRAWLSPACE				400 LF	} ps include K-37
K-12	" "	" "					
K-13	Boiler exp tank wrap <sup>TSI</sup>	Boiler tank Basement				40 SF	} ps include K-38
K-14	" "	" "					
K-15	TSI	end cap of <del>EXP.</del> tank				2 SF	} ps include K-39
K-16	"	" "					
K-17	TSI	hard elbow on Hot water line (CRAWLSPACE)				45	} ps include K-40
K-18	"	" "					

1200500



ASBESTOS BULK SAMPLE SHEET

Job Order No: \_\_\_\_\_ Location: Old MIS Building Date: 1-9-12

Inspector: WGL Signature: WGL Page: 2 of 3

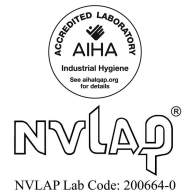
Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
K-19	TSI	inside Baler cabinet			100 SF	] PS include K-41
K-20	"	" " "				
K-21	TSI	soft material on Baler			100 SF	] PS include K-42
K-22	"	" " "				
K-23	Wall board	throughout Attic ceiling/walls				] PS
K-24	"	" " "				
K-25	Window glazing	wood windows			25 windows	] PS
K-26	" "	" "			"	
K-27	Window caulking	wood windows			"	] PS
K-28	" "	" "			"	
K-29	Door caulking	Front / Back ext doors			3 ext doors	] PS
K-30	" "	" "			"	
K-31	PLASTER/SKIN COAT					] PS separate layers.
K-32	" "					
K-33	" "					
K-34	" "					
K-35	" "					





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200500

**Analysis ID:** 1200500\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set K Old MIS  
Building

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
K-1 - A	Plaster/base skimcoat	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_1	finish				Crushed
K-1 - B	Plaster/base skimcoat	None Detected	3% Cellulose	77% Other 20% Quartz	Gray Fibrous Heterogeneous
1200500PLM_43	base				Crushed
K-2 - A	Plaster/skimcoat	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_2	finish				Crushed
K-2 - B	Plaster/skimcoat	None Detected	3% Cellulose	77% Other 20% Quartz	Gray Fibrous Heterogeneous
1200500PLM_44	base				Crushed
K-3	Vinyl floor layer 1	None Detected	20% Cellulose	80% Other	White Fibrous Heterogeneous
1200500PLM_3					Teased
K-4	Vinyl floor layer 1	None Detected	20% Cellulose	80% Other	White Fibrous Heterogeneous
1200500PLM_4					Teased
K-5 - A	FT/mastic layer 2	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_5	tile				Ashed
K-5 - B	FT/mastic layer 2	5% Chrysotile	5% Cellulose	90% Other	Black, Yellow Fibrous Heterogeneous
1200500PLM_45	mastic/felt				Teased, Dissolved

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Ired Gulley (51)

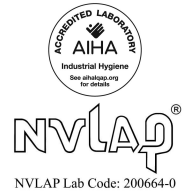
Analyst

Approved Signatory



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Building

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
K-6 - A	FT/mastic layer 2	None Detected		100% Other	Black Non Fibrous Heterogeneous
1200500PLM_6	tile				Ashed
K-6 - B	FT/mastic layer 2	Not Analyzed			
1200500PLM_46	mastic/felt				
K-7	Trowelled texture	None Detected		90% Other 10% Quartz	White Non Fibrous Heterogeneous
1200500PLM_7					Crushed
K-8	Trowelled texture	None Detected		90% Other 10% Quartz	White Non Fibrous Heterogeneous
1200500PLM_8					Crushed
K-9	Hot water line wrap TSI	50% Chrysotile	40% Cellulose	10% Other	White Fibrous Heterogeneous
1200500PLM_9					Teased
K-10	Hot water line wrap TSI	Not Analyzed			
1200500PLM_10					
K-11	Aerocell TSI	40% Chrysotile	40% Cellulose	20% Other	White Fibrous Heterogeneous
1200500PLM_11					Teased
K-12	Aerocell TSI	Not Analyzed			
1200500PLM_12					

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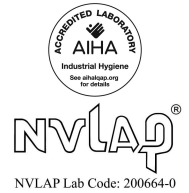
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EPA Method: 600/R-93/116 and 600/M4-82-020



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**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set K Old MIS  
Building

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
K-13	Boiler exp tank wrap TSI	40% Chrysotile	40% Cellulose	20% Other	Gray Fibrous Heterogeneous
1200500PLM_13					Teased
K-14	Boiler exp tank wrap TSI	Not Analyzed			
1200500PLM_14					
K-15	TSI	5% Chrysotile	30% Fiber Glass	65% Other	Brown Fibrous Heterogeneous
1200500PLM_15					Teased
K-16	TSI	Not Analyzed			
1200500PLM_16					
K-17	TSI	8% Chrysotile	30% Fiber Glass	62% Other	Brown Fibrous Heterogeneous
1200500PLM_17					Teased
K-18	TSI	Not Analyzed			
1200500PLM_18					
K-19	TSI	60% Chrysotile	30% Cellulose	10% Other	White Fibrous Heterogeneous
1200500PLM_19					Teased
K-20	TSI	Not Analyzed			
1200500PLM_20					

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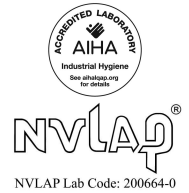
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Building

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
K-21	TSI	5% Chrysotile	30% Fiber Glass	65% Other	Brown Fibrous Heterogeneous
1200500PLM_21					Teased
K-22	TSI	Not Analyzed			
1200500PLM_22					
K-23	Wallboard	None Detected	90% Cellulose	10% Other	Brown, White Fibrous Heterogeneous
1200500PLM_23					Teased
K-24	Wallboard	None Detected	90% Cellulose	10% Other	Brown, White Fibrous Heterogeneous
1200500PLM_24					Teased
K-25	Window glazing	None Detected		100% Other	Tan Non Fibrous Heterogeneous
1200500PLM_25					Crushed
K-26	Window glazing	None Detected		100% Other	Tan Non Fibrous Heterogeneous
1200500PLM_26					Crushed
K-27	Window caulking	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_27					Ashed
K-28	Window caulking	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_28					Ashed

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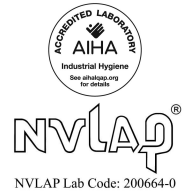
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**Analysis ID:** 1200500\_PL

**Date Received:** 1/12/2012

**Project:** 15111236 IHG-00 Set K Old MIS  
Building

**Date Reported:** 1/17/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
K-29	Door caulking	3% Chrysotile		97% Other	Gray Fibrous Heterogeneous
1200500PLM_29					Crushed
K-30	Door caulking	Not Analyzed			
1200500PLM_30					
K-31 - A	Plaster/skimcoat	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_31	finish				Crushed
K-31 - B	Plaster/skimcoat	None Detected		80% Other 20% Quartz	Gray Non Fibrous Heterogeneous
1200500PLM_47	base				Crushed
K-32 - A	Plaster/skimcoat	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_32	finish				Crushed
K-32 - B	Plaster/skimcoat	None Detected		80% Other 20% Quartz	Gray Non Fibrous Heterogeneous
1200500PLM_48	base				Crushed
K-33 - A	Plaster/skimcoat	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_33	finish				Crushed
K-33 - B	Plaster/skimcoat	None Detected		80% Other 20% Quartz	Gray Non Fibrous Heterogeneous
1200500PLM_49	base				Crushed

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Ired Gulley (51)

Analyst

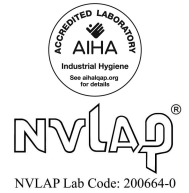
Approved Signatory





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200500

**Analysis ID:** 1200500\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set K Old MIS  
Building

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
K-34 - A	Plaster/skimcoat	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_34	finish				Crushed
K-34 - B	Plaster/skimcoat	None Detected		80% Other 20% Quartz	Gray Non Fibrous Heterogeneous
1200500PLM_50	base				Crushed
K-35 - A	Plaster/skimcoat	None Detected		100% Other	White Non Fibrous Heterogeneous
1200500PLM_35	finish				Crushed
K-35 - B	Plaster/skimcoat	None Detected		80% Other 20% Quartz	Gray Non Fibrous Heterogeneous
1200500PLM_51	base				Crushed
K-36	Hot water line wrap	30% Chrysotile	50% Cellulose	20% Other	Brown, White, Silver Fibrous
1200500PLM_36					Teased, Dissolved
K-37	TSI (aerocell)	Not Analyzed			
1200500PLM_37					
K-38	Boiler exp tank wrap	Not Analyzed			
1200500PLM_38					
K-39	TSI	Not Analyzed			
1200500PLM_39					

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Ired Gulley (51)

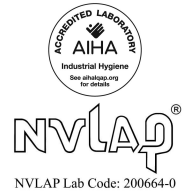
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200500

**Analysis ID:** 1200500\_PL

**Date Received:** 1/12/2012

**Date Reported:** 1/17/2012

**Project:** 15111236 IHG-00 Set K Old MIS  
Building

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
K-40	TSI	Not Analyzed			
1200500PLM_40					
K-41	TSI	50% Chrysotile	40% Cellulose	10% Other	White Fibrous Heterogeneous
1200500PLM_41					Teased
K-42	TSI	5% Chrysotile	40% Fiber Glass	55% Other	Gray Fibrous Heterogeneous
1200500PLM_42					Teased

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Ired Gulley (51)

Analyst

Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
K-1	wood	wall	white	kitchen	1.90	yes
K-2	drywall	wall	white	kitchen	1.90	yes
K-3	wood	door frame	white	kitchen	1.10	yes
K-4	wood	door	white	room 2	1.90	yes
K-5	ceramic	sink	white	kitchen	9.90	yes
K-6	ceramic	tile	white	bathroom	0.10	no
K-7	ceramic	tile	black	bathroom	7.90	yes
K-8	wood	window frame	white	room 5	1.90	yes
K-9	metal	radiator	white	room 5	0.80	yes
K-10	drywall	ceiling	white	room 3	0.02	no
K-11	drywall	ceiling	white	room 1	0.02	no
K-12	drywall	wall	white	room 1	0.18	no
K-13	ceramic	fireplace	black	room 1	5.50	yes
K-14	wood	fireplace mantel	white	room 1	2.50	yes
K-15	wood	door	white	exterior of main entrance	3.70	yes
K-16	wood	door	white	door leading to back porch	2.70	yes
K-17	plaster	wall	white	basement	0.00	no
K-18	metal	pipng	tan	basement	0.12	no
K-19	concrete	floor	gray	basement	0.40	no
K-20	plaster	wall	white	basement	0.01	no
K-21	wood	door frame	white	exterior of main entrance	4.30	yes
K-22	wood	window sill	white	exterior of main entrance	2.40	yes
K-23	concrete	along house	white	main porch area	0.20	no
K-24	concrete	along house	white	main porch area	0.00	no
K-25	metal	pole	white	exterior near back door	0.40	no
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA





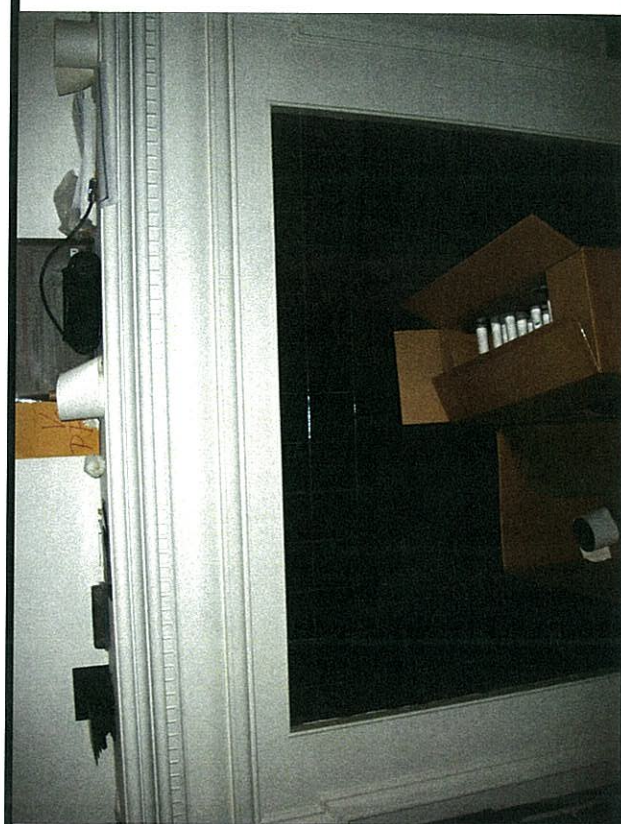
Old M.I.S. Building



Exterior Wooden Window Frames Painted White



Ceramic Sink in Kitchen

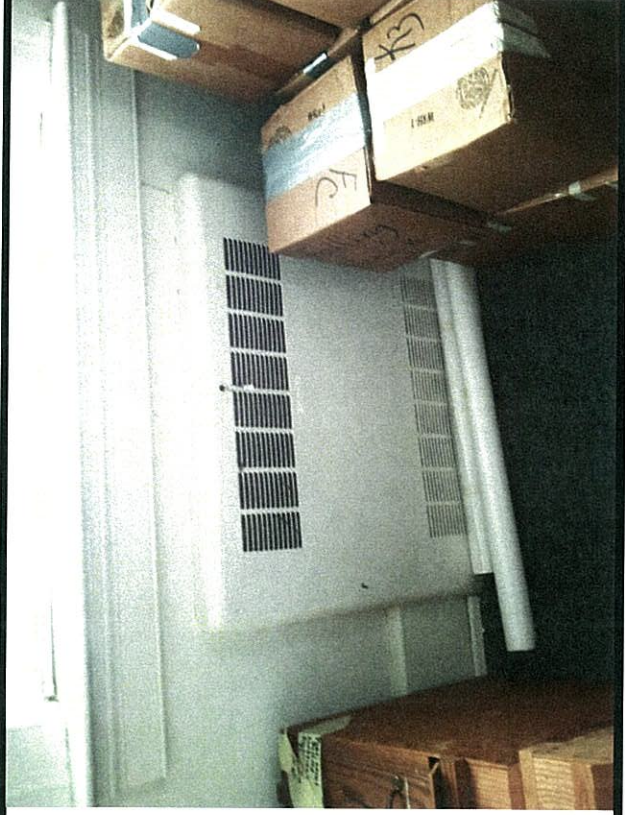


Black Ceramic Tiles Located on Fireplace





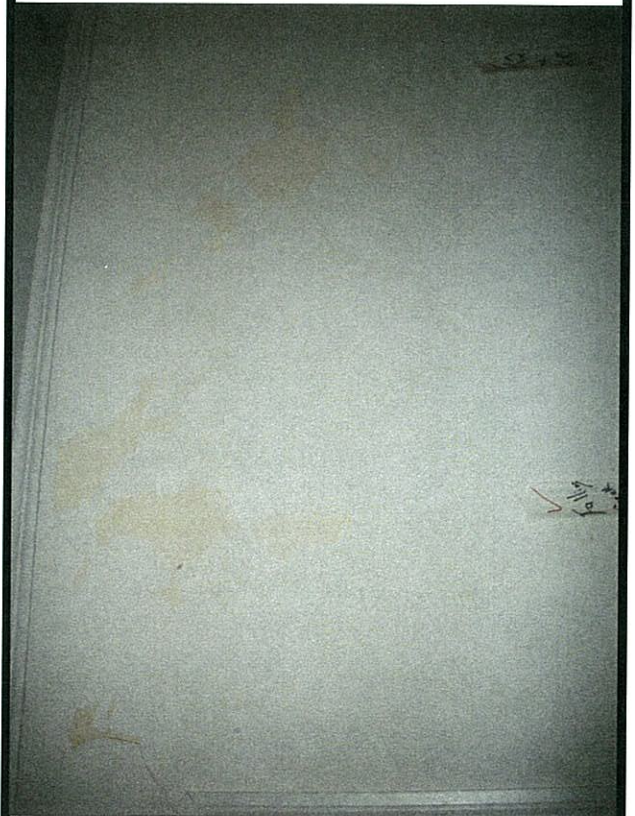
Wooden Exterior Doors Painted White



Radiators Painted White



Black Ceramic Tiles Located in Bathroom



Walls Painted White located Throughout House





Old MIS Building - Assumed Asphalt Roofing Shingles



Asbestos Containing Mastic on the bottom layer of floor tile in the kitchen



Asbestos Containing Pipe Wrap in Basement and Crawl space



Asbestos Containing Aircell insulation beneath pipe wrap





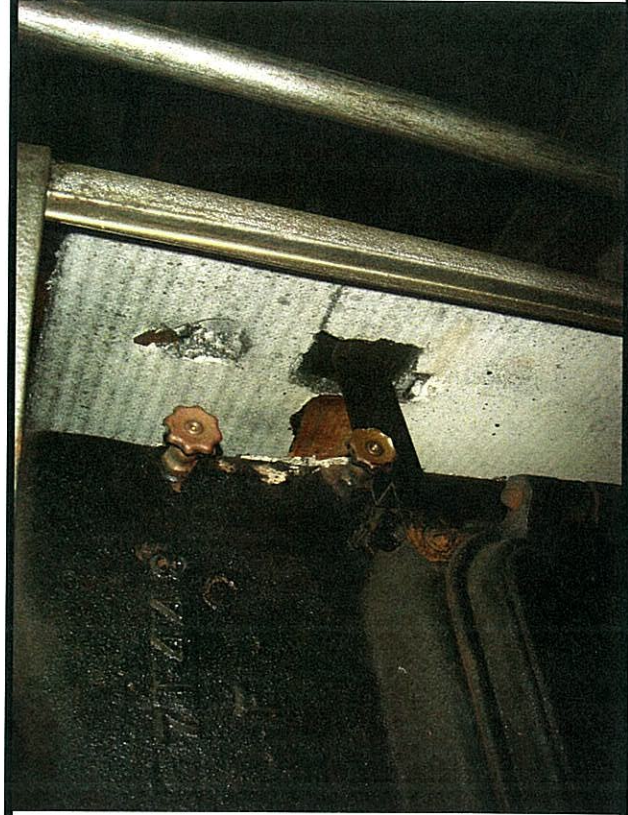
Asbestos Containing insulation on Expansion Tank in Basement



Asbestos containing insulation on the end cap of the expansion tank in the basement



Asbestos Containing Hard elbows on hot water lines in the crawl space and basement

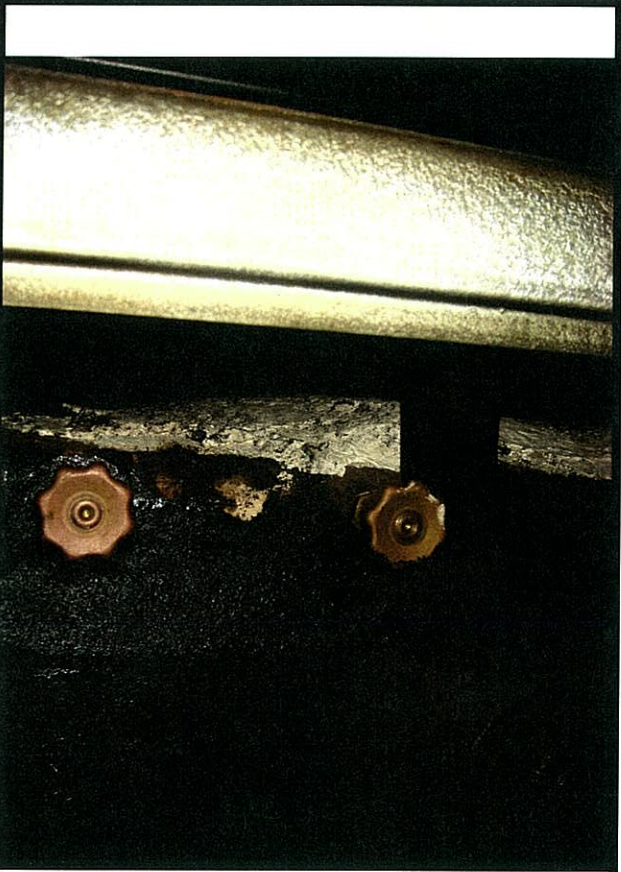


Asbestos Containing Insulation in the Boiler cabinet





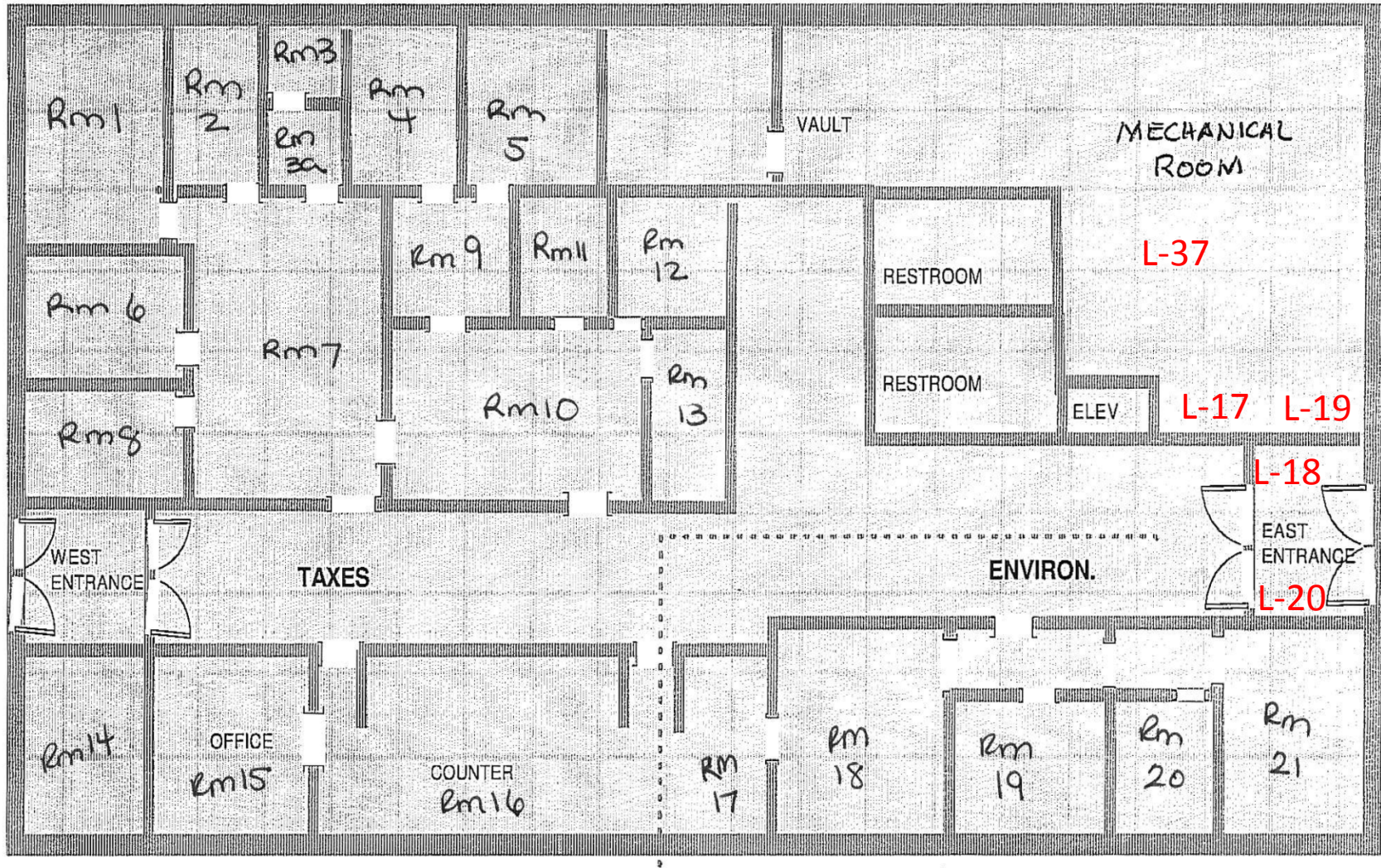
Asbestos Containing Door Caulking on Exterior doors



Asbestos Containing Boiler insulation on boiler in basement



**(L) TAX OFFICE**

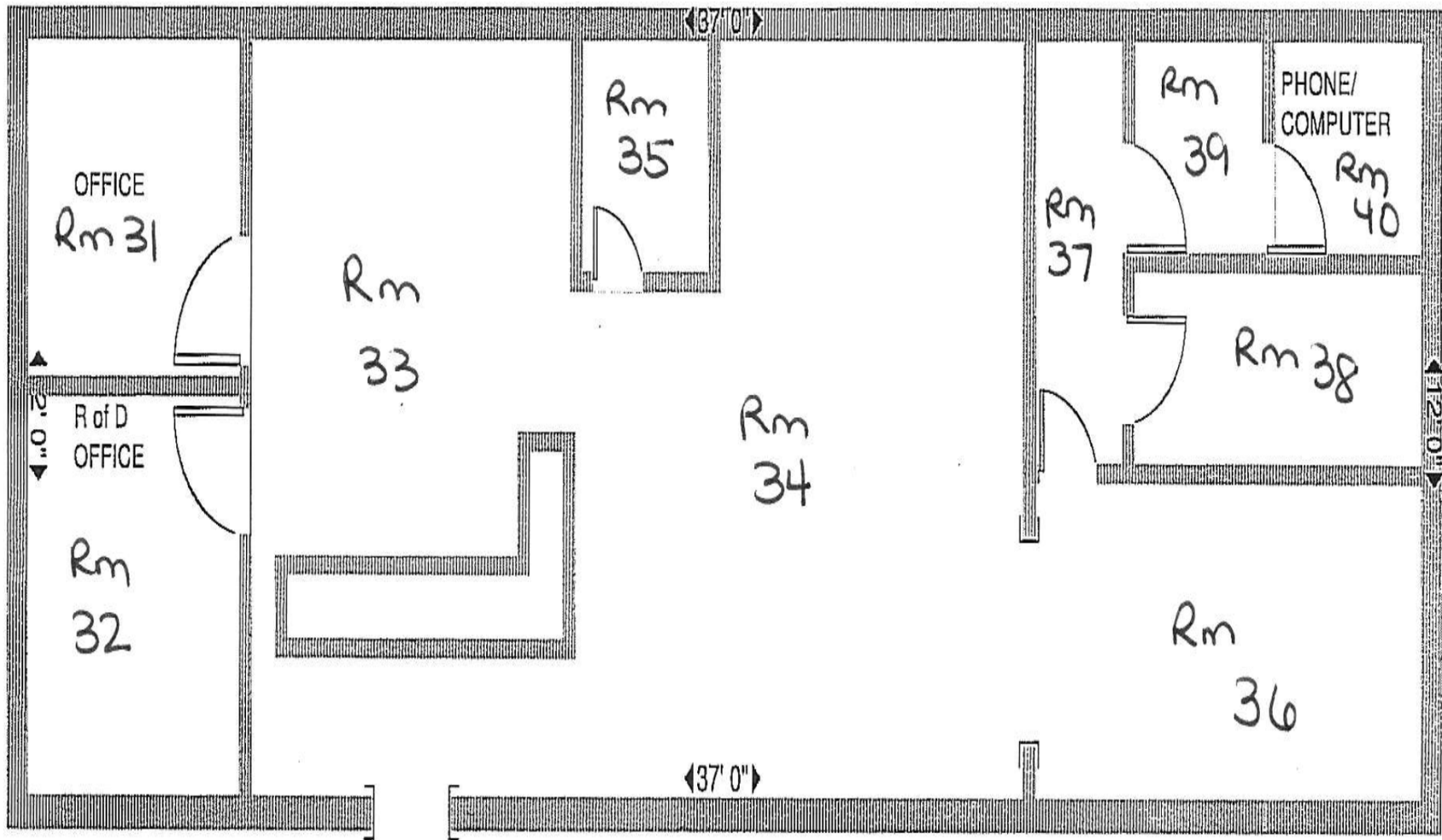


Prepared by  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Tax Office 1<sup>st</sup> Floor**

Notes:  
 9,000 SF of asbestos –containing floor tile and mastic  
 Asbestos-containing door caulk  
 Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502

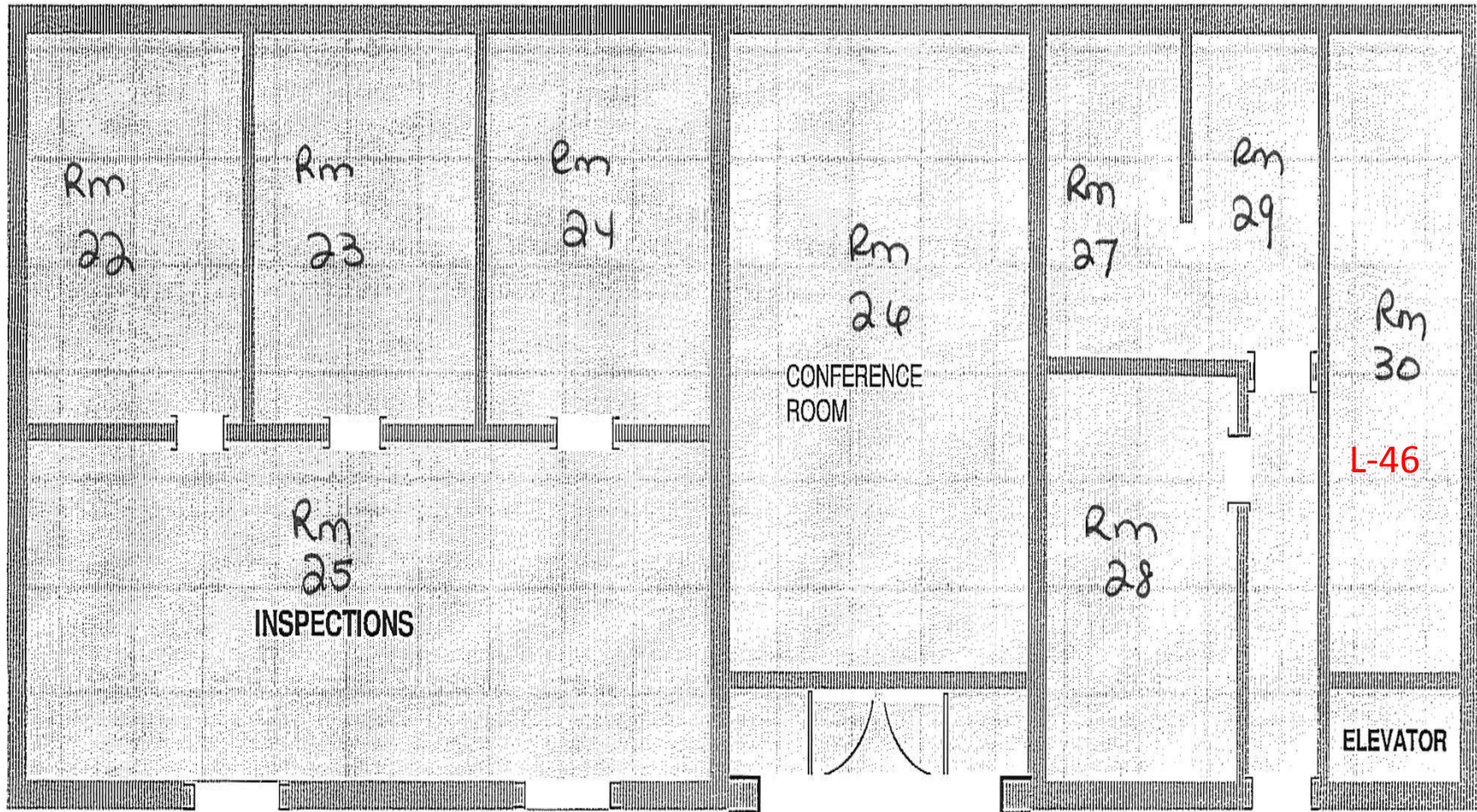


**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**Tax Office 2<sup>nd</sup> Floor South Hallway**  
 Notes:  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502





Prepared by  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

Tax Office 2<sup>nd</sup> Floor North Hallway  
 Notes:  
 9,000 SF of asbestos –containing mastic  
 Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sailab.com lab@sailab.com

1200778

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone <input type="checkbox"/> : 410.891.1726
4601 Six Forks Rd., 220	Fax <input type="checkbox"/> : 410316.7935
Raleigh, NC 27609	Email <input type="checkbox"/> : tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY - TAT.

PO Number: \_\_\_\_\_  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 5 sets.			
set L	Sample # L-1 to L-58		
set M	Sample # M-1 to M-31		
Set N	Sample # N-1 to N-32		
Set O	Sample # O-1 to O-11		
Set P	Sample # P-1 to P-13.		
			Accepted <input checked="" type="checkbox"/> Rejected <input type="checkbox"/>
1) Please apply positive stop as indicated on sampling datasheets.			
2) Please separate and analyze layers for Fibre Tile/Vinyl and Mastics & Plaster samples			
3) Please provide separate reports for each set of samples.			

Total # of Samples \_\_\_\_\_

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/16/2012.		1-17 10A

1200778



ASBESTOS BULK SAMPLE SHEET

Job Order No: 15111236 Location: Tax Bldg Date: 1/12/12  
 Inspector: Tehsin Aurangabadwala Signature: \_\_\_\_\_ Page: 1 of 4

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good/ Damaged	Quantity	Remarks
L-1	Endcap Insulation	Mech. Rm. 6" pipes			21.	} PS.
L-2	Endcap Insulation	Mech. Rm " "				
L-3	Endcap Insulation	Mech Rm " "				
L-4	Endcap Insulation	Mech. Rm " "				
L-5	Breaching wrap	Mech Rm - HVAC unit				} PS
L-6	Breaching wrap	" " " "				
L-7	" "	" " " "				
L-8	2x2 Ceiling Tile grooved	2nd Floor				} PS
L-9	2x2 Ceiling Tile grooved	" "				
L-10	2x2 Ceiling Tile grooved	" "				
L-11	2x4 Ceiling Tile	Elev. Storage Rm by Mech.				} PS
L-12	2x4 Ceiling Tile	" " " "				
L-13	2x4 Ceiling Tile	" " " "				
L-14	Pipe Fitting Insulation	Mech Rm - vertical pipe next to	Ext. Exit door.	Damaged	1 fitting.	} PS
L-15	Pipe Fitting Insulation	Mech Rm " "	"			
L-16	Pipe Fitting Insulation	Mech Rm " "	"			
L-17	12" Floor Tile - off white	Elev. Rm by Mech.		Good.	200 SF.	} On stairs + Elev + Corridor
L-18	12" Floor Tile - off white	Corridor by Elev (Mech Rm.				

Include L-47 for PS.

1200778



ASBESTOS BULK SAMPLE SHEET

Job Order No: 15111236 Location: Tax Bldg Date: 1/12/12  
 Inspector: Tehsin Signature: \_\_\_\_\_ Page: 2 of 4

Sample No	Type of Material	Location / Description	Friable		Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged			
L-19	Mastic - black	beneath L-17	No		Good.	200 SF.	] PS
L-20	Mastic - black	beneath L-18.	No.		"		
L-21	Covebase - brown	Elev. Rm.					] PS
L-22	Cove base - brown	Corridor by Elev. Rm					
L-23	Mastic - brown	behind L-21					] PS
L-24	Mastic - brown.	behind L-22					
L-25	Drywall / Joint Compd	Elev. Rm by Mech.					] PS
L-26	Drywall / Joint Compd.	Storage Closet beneath Stairs by Mech					
L-27	Plaster - skim	" " " " "					] PS - Include
L-28	Plaster - skim	" " " " "					
L-29	Plaster - skim	Corridor by Mech Rm.					] PS - Include
L-30	Plaster - base	Storage Closet beneath Stairs by Mech.					
L-31	Plaster base	" " " " "					] PS - Include
L-32	Plaster base	Corridor by Mech Rm.					
L-33	Covebase - Grey.	East Entrance lobby					] PS
L-34	Covebase - Grey.	West Entrance lobby					
L-35	Mastic - white	behind L-33					] PS
L-36	Mastic - white	behind L-34					

L-53 &  
L-54.  
L-55 &  
L-56

1200778



## ASBESTOS BULK SAMPLE SHEET

Job Order No: 15111236.

Location: Tax Bldg.

Date: 1/12/12

Inspector: Tehsin

Signature: \_\_\_\_\_

Page: 3 of 4

Sample No	Type of Material	Location / Description	Friable	Condition	Quantity	Remarks
			Yes / No / Potential	Good/ Damaged		
L-37	Door Caulk	East Entrance door to Mech Area		Good.		] PS
L-38	Door Caulk.	" " " " " "		Good.		] PS
L-39	Terrazzo flooring	East Entrance Lobby				] PS
L-40	Terrazzo flooring.	West Entrance Lobby				] PS
L-41	1x1 Ceiling tile - spline	Environ Corridor 1 <sup>st</sup> Fl.				] PS
L-42	1x1 Ceiling tile - spline	Taxes Corridor 1 <sup>st</sup> Fl.				] PS
L-43	1x1 Ceiling tile - spline	Corridor by Rest Room - 1 <sup>st</sup> Fl.				] PS
L-44	Carpet Mastic Yellow	1 <sup>st</sup> Floor Vault.				] PS
L-45	Carpet Mastic Yellow.	1 <sup>st</sup> Floor Vault.				] PS
L-46	Carpet Mastic Yellow	2nd Floor. Rm 30 (mail Rm)				] PS
L-47	12" Floor Tile offwhite	beneath L-46.				] Include for PS with L-17/L-18
L-48	Mastic Black.	beneath L-47.				] Include for PS with L-19/L-20 Rm 39+40.
L-49	12" Floor Tile - light brown w/specks	Break Room Storage 2nd Fl.			40 SF.	+ 240 SF - 2nd Fl - Comp.
L-50	12" Floor Tile - L. brown w/specks.	Break Room Kitchen - 2nd Fl.			50 SF.	
L-51	Mastic - Yellow	beneath L-49				] PS.
L-52	Mastic - Yellow.	beneath L-50.				] PS.
L-53	Plaster - skim	2nd Fl. Stair by Elevator. (stair to Roof)				] Include for PS with L-27 & L-29.
L-54	Plaster - skim	" " " " " "				] PS.

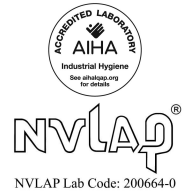






# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200778

**Analysis ID:** 1200778\_PL

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Tax Bldg Set L

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
L-1	Endcap insulation	None Detected	10% Fiber Glass	90% Other	Gray Non Fibrous Homogeneous
1200778PLM_1					Crushed
L-2	Endcap insulation	None Detected	10% Fiber Glass	90% Other	Gray Non Fibrous Homogeneous
1200778PLM_2					Crushed
L-3	Endcap insulation	None Detected	10% Fiber Glass	90% Other	Gray Non Fibrous Homogeneous
1200778PLM_3					Crushed
L-4	Endcap insulation	None Detected	10% Fiber Glass	90% Other	Gray Non Fibrous Homogeneous
1200778PLM_4					Crushed
L-5	Breeching wrap	None Detected	90% Cellulose	10% Other	Gray, White Non Fibrous Homogeneous
1200778PLM_5					Teased
L-6	Breeching wrap	None Detected	90% Cellulose	10% Other	Gray, White Non Fibrous Homogeneous
1200778PLM_6					Teased
L-7	Breeching wrap	None Detected	90% Cellulose	10% Other	Gray, White Non Fibrous Homogeneous
1200778PLM_7					Teased
L-8	2x2 ceiling tile grooved	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200778PLM_8					Teased

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Bart Huber (58)

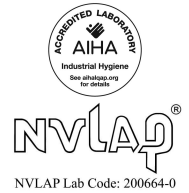
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200778

**Analysis ID:** 1200778\_PL

**Date Received:** 1/17/2012

**Date Reported:** 1/23/2012

**Project:** 15111236 IHG-00 Tax Bldg Set L

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
L-9	2x2 ceiling tile grooved	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200778PLM_9					Teased
L-10	2x2 ceiling tile grooved	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200778PLM_10					Teased
L-11	2x4 ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200778PLM_11					Teased
L-12	2x4 ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200778PLM_12					Teased
L-13	2x4 ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200778PLM_13					Teased
L-14	Pipe fitting insulation	None Detected	10% Fiber Glass	90% Other	Gray Non Fibrous Homogeneous
1200778PLM_14					Crushed
L-15	Pipe fitting insulation	None Detected	10% Fiber Glass	90% Other	Gray Non Fibrous Homogeneous
1200778PLM_15					Crushed
L-16	Pipe fitting insulation	None Detected	10% Fiber Glass	90% Other	Gray Non Fibrous Homogeneous
1200778PLM_16					Crushed

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Bart Huber (58)

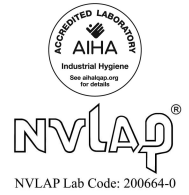
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200778

**Analysis ID:** 1200778\_PL

**Date Received:** 1/17/2012

**Date Reported:** 1/23/2012

**Project:** 15111236 IHG-00 Tax Bldg Set L

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
L-17	12" floor tile off-white	3% Chrysotile		97% Other	White Non Fibrous Homogeneous
1200778PLM_17					Dissolved
L-18	12" floor tile off-white	Not Analyzed			
1200778PLM_18					
L-19	Mastic-black	8% Chrysotile		92% Other	Black Non Fibrous Homogeneous
1200778PLM_19					Dissolved
L-20	Mastic-black	Not Analyzed			
1200778PLM_20					
L-21	Covebase-brown	None Detected		100% Other	Brown Non Fibrous Homogeneous
1200778PLM_21					Dissolved
L-22	Covebase-brown	None Detected		100% Other	Brown Non Fibrous Homogeneous
1200778PLM_22					Dissolved
L-23	Mastic-brown	None Detected		100% Other	Brown Non Fibrous Homogeneous
1200778PLM_23					Dissolved
L-24	Mastic-brown	None Detected		100% Other	Brown Non Fibrous Homogeneous
1200778PLM_24					Dissolved

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Bart Huber (58)

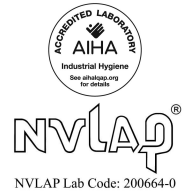
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200778

**Analysis ID:** 1200778\_PL

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Tax Bldg Set L

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
L-25	Drywall/joint compound	None Detected	12% Cellulose 5% Fiber Glass	83% Other	White, Brown Non Fibrous Heterogeneous
1200778PLM_25	<i>drywall and paint</i>				Crushed
L-26	Drywall/joint compound	None Detected	12% Cellulose 5% Fiber Glass	83% Other	White, Brown Non Fibrous Heterogeneous
1200778PLM_26	<i>drywall: none detect; joint compnd: none detect</i>				Crushed
L-27	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200778PLM_27					Crushed
L-28	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200778PLM_28					Crushed
L-29	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200778PLM_29					Crushed
L-30	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200778PLM_30					Crushed
L-31	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200778PLM_31					Crushed
L-32	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200778PLM_32					Crushed

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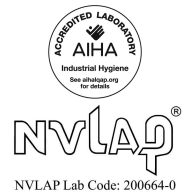
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By Polarized Light Microscopy  
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**Project:** 15111236 IHG-00 Tax Bldg Set L

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
L-33	Covebase - grey	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200778PLM_33					Dissolved
L-34	Covebase - grey	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200778PLM_34					Dissolved
L-35	Mastic - white	None Detected		100% Other	White Non Fibrous Homogeneous
1200778PLM_35					Dissolved
L-36	Mastic - white	None Detected		100% Other	White Non Fibrous Homogeneous
1200778PLM_36					Dissolved
L-37	Door caulk	3% Chrysotile		97% Other	Cream Non Fibrous Homogeneous
1200778PLM_37					Crushed
L-38	Door caulk	Not Analyzed			
1200778PLM_38					
L-39	Terrazzo flooring	None Detected		100% Other	Cream Non Fibrous Heterogeneous
1200778PLM_39					Crushed
L-40	Terrazzo flooring	None Detected		100% Other	Cream Non Fibrous Heterogeneous
1200778PLM_40					Crushed

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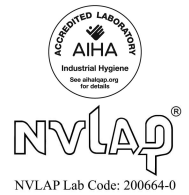
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# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



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**Lab Order ID:** 1200778

**Analysis ID:** 1200778\_PL

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Tax Bldg Set L

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
L-41	1x1 ceiling tile - spline	None Detected	95% Fiber Glass	5% Other	White Non Fibrous Homogeneous
1200778PLM_41					Teased
L-42	1x1 ceiling tile - spline	None Detected	95% Fiber Glass	5% Other	White Non Fibrous Homogeneous
1200778PLM_42					Teased
L-43	1x1 ceiling tile - spline	None Detected	95% Fiber Glass	5% Other	White Non Fibrous Homogeneous
1200778PLM_43					Teased
L-44	Carpet mastic yellow	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Homogeneous
1200778PLM_44					Dissolved
L-45	Carpet mastic yellow	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Homogeneous
1200778PLM_45					Dissolved
L-46	Carpet mastic yellow	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Homogeneous
1200778PLM_46					Dissolved
L-47	12" floor tile off-white	Not Analyzed			
1200778PLM_47					
L-48	Mastic black	Not Analyzed			
1200778PLM_48					

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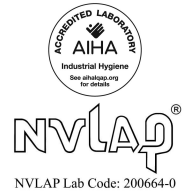
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**Lab Order ID:** 1200778

**Analysis ID:** 1200778\_PL

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Tax Bldg Set L

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
L-49	12" floor tile - light brown w/specks	None Detected		100% Other	Tan Non Fibrous Homogeneous
1200778PLM_49					Dissolved
L-50	12" floor tile - light brown w/ specks	None Detected		100% Other	Tan Non Fibrous Homogeneous
1200778PLM_50					Dissolved
L-51	Mastic-yellow	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200778PLM_51					Dissolved
L-52	Mastic-yellow	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200778PLM_52					Dissolved
L-53	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200778PLM_53					Crushed
L-54	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200778PLM_54					Crushed
L-55	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200778PLM_55					Crushed
L-56	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200778PLM_56					Crushed

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Bart Huber (58)

Analyst

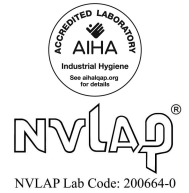
Approved Signatory





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



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Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200778

**Analysis ID:** 1200778\_PL

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Tax Bldg Set L

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
L-57	2x2 ceiling tile - dots	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200778PLM_57					Teased
L-58	2x2 ceiling tile - dots	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200778PLM_58					Teased

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Bart Huber (58)

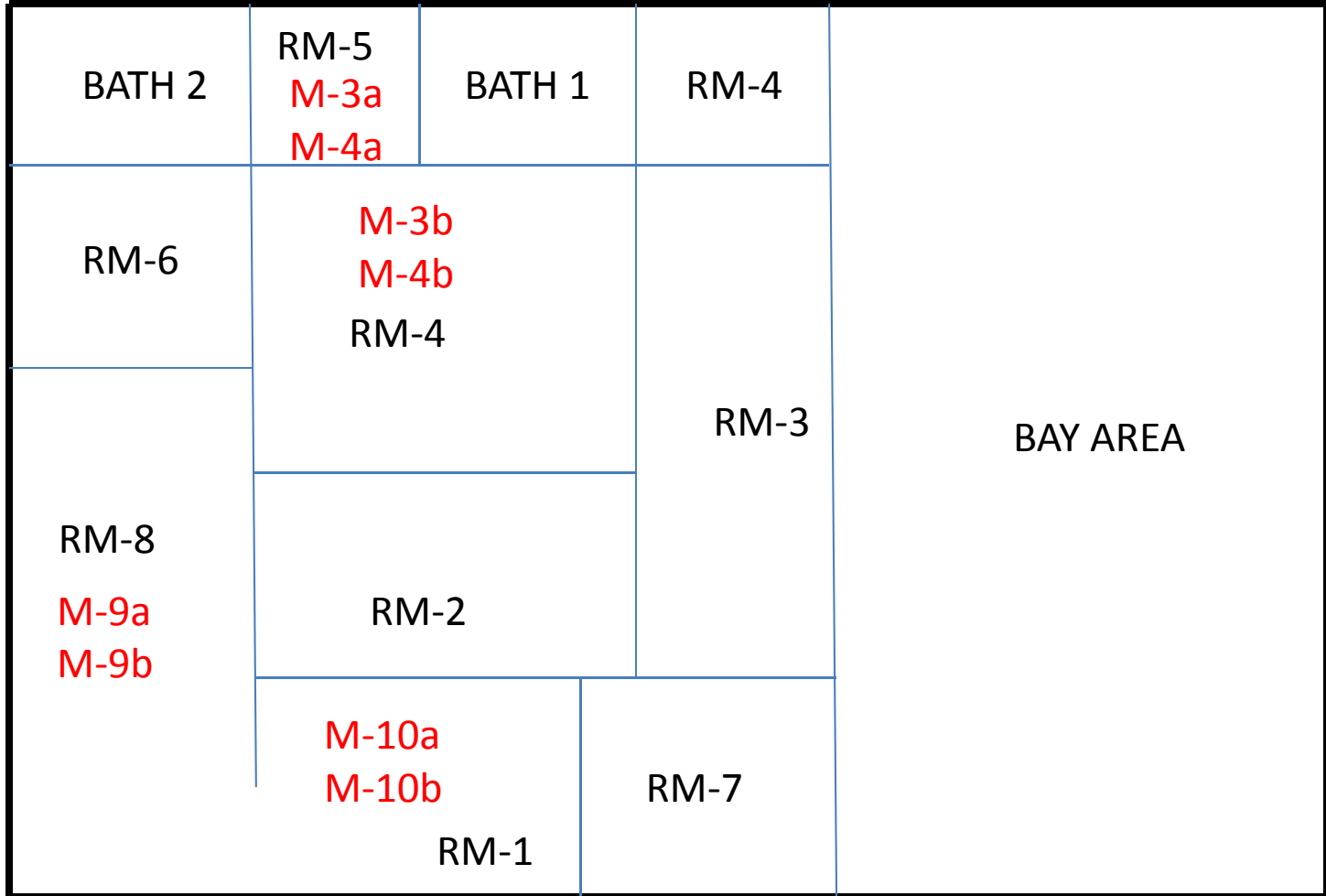
Analyst

Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
L-1	drywall	wall c	white	mechanical room	0.07	no
L-2	concrete	wall b	white	mechanical room	0.09	no
L-3	metal	door frame	white	mechanical room	0.04	no
L-4	metal	door	white	mechanical room	0.04	no
L-5	metal	door	brown	mechanical room	0.00	no
L-6	wood	door	white	outside of mechanical room	0.04	no
L-7	drywall	wall c	white	outside of mechanical room	0.01	no
L-8	metal	railing	brown	outside of mechanical room stairs	0.18	no
L-9	metal	door frame	brown	east entrance	0.03	no
L-10	metal	door	brown	east entrance	0.09	no
L-11	drywall	door	tan/brown	room 21	0.02	no
L-12	metal	door frame	dark brown	room 21	0.01	no
L-13	wood	door	light brown	room 17	0.00	no
L-14	wood	door frame	dark brown	room 17	0.00	no
L-15	wood	door	tan/brown	room 7	0.00	no
L-16	drywall	wall	tan specs	room 7	0.00	no
L-17	plaster	wall c	cream	vault	0.00	no
L-18	drywall	wall a	white	vault	0.00	no
L-19	drywall	wall d	wallpaper	room 31	0.02	no
L-20	wood	frame	brown	between 34 and 36	0.05	no
L-21	drywall	wall	cream	room 38	0.03	no
L-22	metal	door frame	black	room 38	0.60	no
L-23	metal	door	black	room 38	0.50	no
L-24	drywall	wall b	yellow	room 27	0.00	no
L-25	wood	door	white	room 29	0.06	no
L-26	wood	door frame	white	room 29	0.00	no
L-27	wood	baseboard	white	room 29	0.01	no
L-28	plaster	wall	brown	stairs	0.27	no
Cal1		SRM - 2579	Red	Calibration Test	1.00	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA

**(M) EMS STATION #1**



**Prepared by**  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

**EMS Station #1**  
 Notes:  
 170 SF of asbestos-containing floor tile and mastic  
 Floor Plan to be used for purpose of this report only

**Prepared for**  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sallab.com lab@sallab.com

1200783

Lab Use Only
Lab Order ID: _____
Client Code: _____

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone <input type="checkbox"/> : 410.891.1726
4601 Six Forks Rd., 220	Fax <input type="checkbox"/> : 410316.7935
Raleigh, NC 27609	Email <input type="checkbox"/> : tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHRA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY - TAT.

PO Number: _____
Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 5 sets.			
set L	Sample # L-1 to L-58		
set M	Sample # M-1 to M-31		
Set N	Sample # N-1 to N-32		
Set O	Sample # O-1 to O-11		Accepted <input checked="" type="checkbox"/> Rejected <input type="checkbox"/>
Set P	Sample # P-1 to P-13		
1) Please apply positive stop as indicated on sampling datasheets. 2) Please separate and analyze layers for Floor Tile/Vinyl and Mastics & Plaster samples 3) Please provide separate reports for each set of samples.			

Total # of Samples \_\_\_\_\_

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/16/2012		1-17-10A

1200783



## ASBESTOS BULK SAMPLE SHEET

Job Order No: \_\_\_\_\_

Location: \_\_\_\_\_

EMS Station 1 (M)

Date: 1-10-12

Inspector: WILLIAM S. LANE

Signature: WSK

Page: 1 of 2

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good / Damaged	Quantity	Remarks
M-01	SR / JC	throughout				7 PS
M-02	SR / JC	" "				7 PS
M-03	FT / Mastic	layer 2 RM 4, RM 5			170 SF	7 PS Separate layers
M-04	" "	" "				7 PS Separate layers
M-05	vinyl / mastic	Kitchen layer 1				7 PS Separate layers
M-06	" "	" "				7 PS Separate layers
M-07	carpet mastic	Blue <sup>grey</sup> carpet RM 8				7 PS
M-08	" "	" "				7 PS
M-09	FT / mastic	RM 2, RM 1, RM 7			324 SF	7 PS Separate layers
M-10	" "	" "				7 PS Separate layers
M-11	Carpet mastic	Blue carpet <sup>Bath 2</sup>				7 PS
M-12	" "	" "				7 PS
M-13	Pipe wrap paper	RM 8				7 PS
M-14	" "	" "				7 PS
M-15	2x2 ceiling tile white	throughout				7 PS
M-16	" "	" "				7 PS
M-17	cove base / mastic (black)	throughout except RM 4 & 5				7 PS Separate layers.
M-18	" "	" "				7 PS Separate layers.

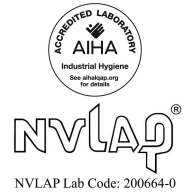
M-11  
M-12





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



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4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200783

**Analysis ID:** 1200783\_PL

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 EMS Station 1 Set M

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
M-01	SR/JC	<b>None Detected</b>	12% Cellulose	88% Other	White, Brown Non Fibrous Heterogeneous
1200783PLM_1	sheetrock: none detect; joint compnd: none detect				Crushed
M-02	SR/JC	<b>None Detected</b>	12% Cellulose	88% Other	White, Brown Non Fibrous Heterogeneous
1200783PLM_2	sheetrock: none detect; joint compnd: none detect				Crushed
M-03 - A	FT/mastic	<b>3% Chrysotile</b>		97% Other	White Non Fibrous Homogeneous
1200783PLM_3	tile				Dissolved
M-03 - B	FT/mastic	<b>8% Chrysotile</b>		92% Other	Black Non Fibrous Homogeneous
1200783PLM_32	mastic				Dissolved
M-04 - A	FT/mastic	<b>Not Analyzed</b>			
1200783PLM_4	tile				
M-04 - B	FT/mastic	<b>Not Analyzed</b>			
1200783PLM_33	mastic				
M-05	Vinyl/mastic	<b>None Detected</b>		100% Other	Tan Non Fibrous Homogeneous
1200783PLM_5	vinyl only				Dissolved
M-06	Vinyl/mastic	<b>None Detected</b>		100% Other	Tan Non Fibrous Homogeneous
1200783PLM_6	vinyl only				Dissolved

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Bart Huber (39)

Analyst

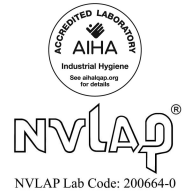
Approved Signatory





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**Analysis ID:** 1200783\_PL

**Date Received:** 1/17/2012

**Date Reported:** 1/23/2012

**Project:** 15111236 IHG-00 EMS Station 1 Set M

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
M-07	Carpet mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200783PLM_7					Dissolved
M-08	Carpet mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200783PLM_8					Dissolved
M-09 - A	FT/mastic	3% Chrysotile		97% Other	White Non Fibrous Homogeneous
1200783PLM_9	tile				Dissolved
M-09 - B	FT/mastic	8% Chrysotile		92% Other	Black Non Fibrous Homogeneous
1200783PLM_34	mastic				Dissolved
M-10 - A	FT/mastic	Not Analyzed			
1200783PLM_10	tile				
M-10 - B	FT/mastic	Not Analyzed			
1200783PLM_35	mastic				
M-11	Carpet mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200783PLM_11					Dissolved
M-12	Carpet mastic	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200783PLM_12					Dissolved

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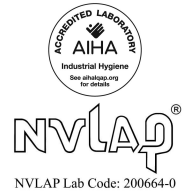
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**Analysis ID:** 1200783\_PL

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 EMS Station 1 Set M

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
M-13	Pipe wrap paper	None Detected	85% Cellulose 10% Fiber Glass	5% Other	White Non Fibrous Homogeneous
1200783PLM_13					Teased
M-14	Pipe wrap paper	None Detected	85% Cellulose 10% Fiber Glass	5% Other	White Non Fibrous Homogeneous
1200783PLM_14					Teased
M-15	2x2 ceiling tile white	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200783PLM_15					Teased
M-16	2x2 ceiling tile white	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200783PLM_16					Teased
M-17 - A	Covebase/mastic (black)	None Detected		100% Other	Black Non Fibrous Homogeneous
1200783PLM_17	covebase				Dissolved
M-17 - B	Covebase/mastic (black)	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200783PLM_36	mastic				Dissolved
M-18 - A	Covebase/mastic (black)	None Detected		100% Other	Black Non Fibrous Homogeneous
1200783PLM_18	covebase				Dissolved
M-18 - B	Covebase/mastic (black)	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200783PLM_37	mastic				Dissolved

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Bart Huber (39)

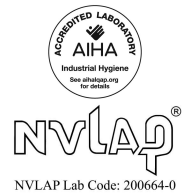
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200783

**Analysis ID:** 1200783\_PL

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 EMS Station 1 Set M

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
M-19 - A	Covebase/mastic (blue)	None Detected		100% Other	Blue Non Fibrous Homogeneous
1200783PLM_19	covebase				Dissolved
M-19 - B	Covebase/mastic (blue)	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200783PLM_38	mastic				Dissolved
M-20 - A	Covebase/mastic (blue)	None Detected		100% Other	Blue Non Fibrous Homogeneous
1200783PLM_20	covebase				Dissolved
M-20 - B	Covebase/mastic (blue)	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200783PLM_39	mastic				Dissolved
M-21	Stucco ext	None Detected		100% Other	White Non Fibrous Homogeneous
1200783PLM_21					Crushed
M-22	Stucco ext	None Detected		100% Other	White Non Fibrous Homogeneous
1200783PLM_22					Crushed
M-23	Ext door caulking	None Detected		100% Other	White Non Fibrous Homogeneous
1200783PLM_23					Dissolved
M-24	Ext door caulking	None Detected		100% Other	White Non Fibrous Homogeneous
1200783PLM_24					Dissolved

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Bart Huber (39)

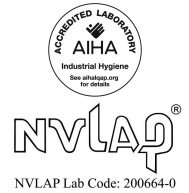
Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200783

**Analysis ID:** 1200783\_PL

**Date Received:** 1/17/2012

**Date Reported:** 1/23/2012

**Project:** 15111236 IHG-00 EMS Station 1 Set M

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
M-25	Window caulking	None Detected		100% Other	Tan Non Fibrous Homogeneous
1200783PLM_25					Dissolved
M-26	Window caulking	None Detected		100% Other	Tan Non Fibrous Homogeneous
1200783PLM_26					Dissolved
M-27	Window glazing	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200783PLM_27					Crushed
M-28	Window glazing	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200783PLM_28					Crushed
M-29	Ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200783PLM_29					Teased
M-30	Ceiling tile	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200783PLM_30					Teased
M-31	Stucco ext	None Detected		100% Other	White Non Fibrous Homogeneous
1200783PLM_31					Crushed

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Bart Huber (39)

Analyst

Approved Signatory

### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.00	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA
M-1	drywall	wall c	white	Room 6	0.00	no
M-2	concrete	wall b	white	Room 6	0.01	no
M-3	wood	window sill	white	Room 6	0.00	no
M-4	wood	door frame	white	Room 6	0.00	no
M-5	ceramic	tile	white	men's bathroom	0.50	no
M-6	drywall	wall d	blue	kitchen	0.00	no
M-7	drywall	wall b	cream	room 1	0.00	no
M-8	metal	door	cream	room 1 leading to bay area	0.00	no
M-9	wood	door	cream	room 1	0.00	no
M-10	wood	door frame	cream	room 1	0.00	no
M-11	concrete	wall a	cream	room 7	0.00	no
M-12	drywall	wall b	white	room 7	0.00	no
M-13	drywall	wall d	green	room 8	0.00	no
M-14	metal	door	white	room 1	0.06	no
M-15	metal	door frame	white	room 1	0.00	no
M-16	concrete	wall d	white	bay area	0.00	no
M-17	wood	door	white	bay area	0.00	no
M-18	drywall	wall b	cream	bay area closet	0.02	no
M-19	concrete	floor	gray	bay area	0.04	no
M-20	metal	door	white	back bay area	0.02	no
M-21	metal	bay doors	white	exterior of bay area	0.00	no
M-22	metal	door	white	exterior side of bay area	0.00	no
M-23	brick	window sill	white	exterior of back main lobby	0.00	no
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA

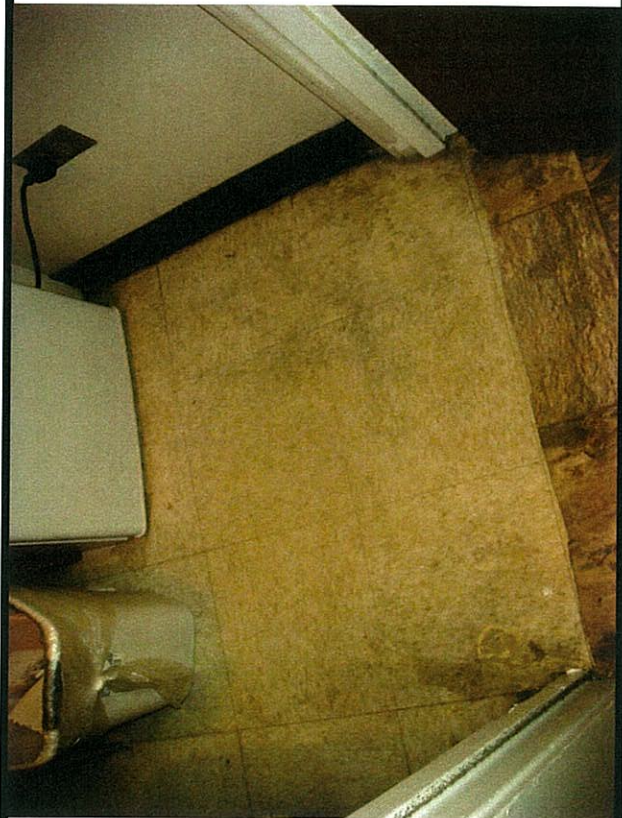




EMS Station 1 . Assumed Asbestos Containing Roofing and Mastics



Example of Assumed Asbestos containing Vibration Damper



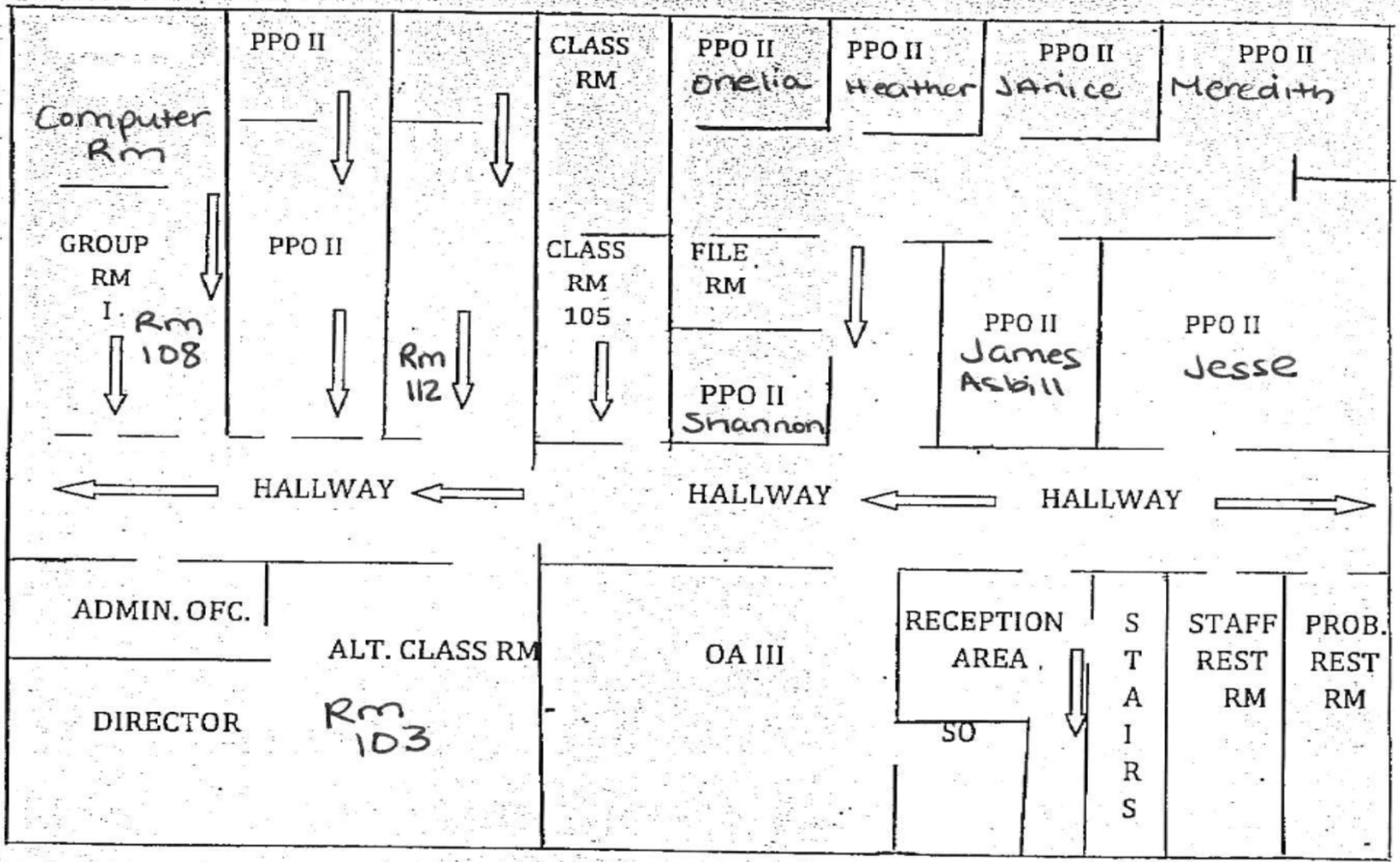
Asbestos Containing Floor tile and mastic in Room 4 and 5



Asbestos Containing Floor tile and Mastic in Room 1,2,7,and 8

**(N) HANNIBAL BUILDING**





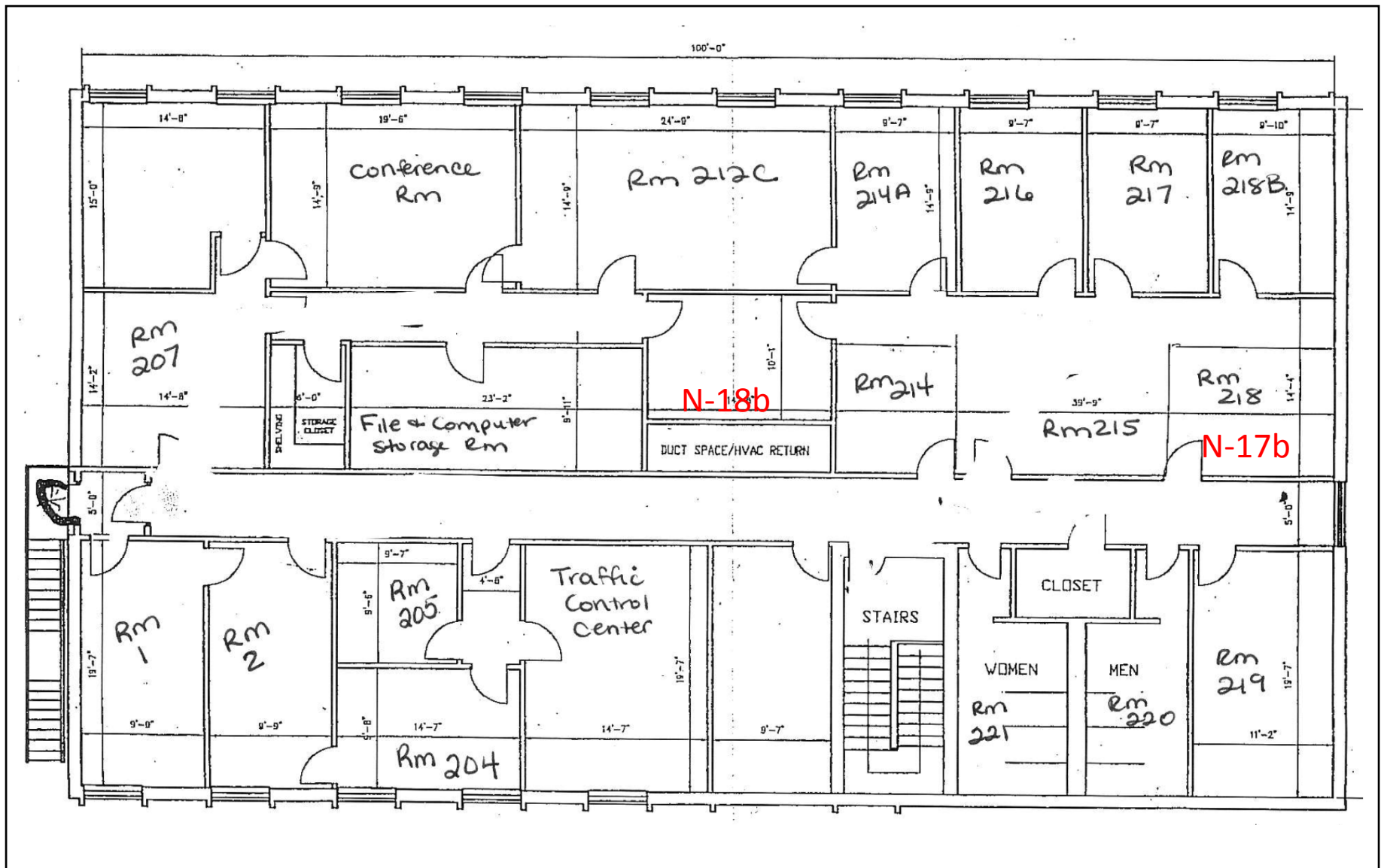
Prepared by  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

Hannibal Building 1<sup>st</sup> Floor

Notes:  
 Over 12,000 SF of drywall  
 Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502





Prepared by  
 KCI Associates of North Carolina, P.A  
 4601 Six Forks Road Landmark Center II, Suite 220  
 Raleigh, NC 27609  
 KCI Project No: 15111236

Hannibal Building 2<sup>nd</sup> Floor

Notes:  
 Over 12,000 SF of drywall  
 Floor Plan to be used for purpose of this report only

Prepared for  
 County of Lenoir  
 130 South Queen Street,  
 Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sallab.com lab@sallab.com

1200781

*Lab Use Only*  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone ☐: 410.891.1726
4601 Six Forks Rd., 220	Fax ☐: 410316.7935
Raleigh, NC 27609	Email ☐: tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other:	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY - TAT.

PO Number: \_\_\_\_\_  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 5 sets.			
Set L	Sample # L-1 to L-58		
Set M	Sample # M-1 to M-31		
Set N	Sample # N-1 to N-32		
Set O	Sample # O-1 to O-11		
Set P	Sample # P-1 to P-13		
Accepted <input checked="" type="checkbox"/> Rejected <input type="checkbox"/>			
1) Please apply positive stop as indicated on sampling datasheets. 2) Please separate and analyze layers for Floor Tile/Vinyl and Mastics & Plaster samples 3) Please provide separate reports for each set of samples.			

Total # of Samples \_\_\_\_\_

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/16/2012		1-17-10A



ASBESTOS BULK SAMPLE SHEET

1200781

Job Order No: 15111236 Location: Hanibal Bldg. Date: 1/9/2012  
 Inspector: Tehsin Aurangabadwala Signature: \_\_\_\_\_ Page: 1 of 2

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good/ Damaged	Quantity	Remarks
N-1	Ceiling Tile (2x4)	2nd Fl. Corridor				} Positive stop.
N-2	Ceiling Tile (2x4)	2nd Fl. Corridor				
N-3	Carpet Mastic - Yellow	2nd Fl. Corridor				} P.S.
N-4	Carpet Mastic - Yellow	1st Fl. Corridor by Storage				
N-5	12" Floor Tile - white	beneath N-3				} PS
N-6	12" Floor Tile - white	beneath N-4				
N-7	Mastic - black	under N-5				} PS
N-8	Mastic - black	under N-6				
N-9	Plaster - skim	2nd Floor - Closet 222				} PS all skim plaster and all base plaster. (Include N-23 to N-26)
N-10	Plaster - base	2nd Floor - Closet 222				
N-11	Plaster - skim	2nd Floor - Restroom 221				
N-12	Plaster - base	2nd Floor - Restroom 221				
N-13	Plaster - skim	2nd Floor - Closet 222				
N-14	Plaster - base	2nd Floor - Closet 222				
N-15	Mastic - Yellow	2nd Floor Corridor by 222/black CB.				} P.S.
N-16	Mastic - Yellow	2nd Floor Corridor by 215/black CB				
N-17	Drywall / Joint Compd.	Rm 218				} PS.
N-18	Drywall / Joint Compd	2nd Floor - Duct Space				

1200781



ASBESTOS BULK SAMPLE SHEET

Job Order No: 1511236 Location: Hanibal Bldg. Date: 11/9/2012  
 Inspector: Tehsin Aurangabadwala Signature: \_\_\_\_\_ Page: 2 of 2

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good/ Damaged	Quantity	Remarks
N-19	Mastic - Yellow	2nd Floor. TSCA Rm1   grey CB				] PS
N-20	Mastic - Yellow	2nd Floor. TSCA Rm2   grey CB				
N-21	Terrazzo flooring	Stairs				] PS.
N-22	Terrazzo flooring	Stair landing.				
N-23	Plaster - skim	1st Floor, DRC-Comp Rm(Ext.wall) Rm 108.				] Include for PS with. N-9 - N-14.
N-24	Plaster - base	1st Floor, DRC-Comp Rm 108.				
N-25	Plaster - skim	1st Floor - Rm 112				
N-26	Plaster - base	1st Floor Rm 112				
N-27	Window Caulk - white	Exterior Bldg.				] PS.
N-28	Window Caulk - white	Exterior Bldg.				
N-29	Covebase - Black	2nd Floor Corridor by 222				] PS
N-30	Covebase - Black	2nd Floor Corridor by 215				
N-31	Covebase - Grey	2nd Floor TSCA Rm				] PS.
N-32	Covebase - Grey	2nd Floor TSCA Rm				

# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200781

**Analysis ID:** 1200781PLM

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Hanibal Bldg Set N

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
N-1	Ceiling tile (2x4)	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200781PLM_1					Teased
N-2	Ceiling tile (2x4)	None Detected	40% Cellulose 40% Fiber Glass	20% Other	White Non Fibrous Homogeneous
1200781PLM_2					Teased
N-3	Carpet mastic - yellow	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200781PLM_3					Dissolved
N-4	Carpet mastic - yellow	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200781PLM_4					Dissolved
N-5	12" floor tile - white	None Detected	3% Cellulose	97% Other	White Non Fibrous Homogeneous
1200781PLM_5					Dissolved
N-6	12" floor tile - white	None Detected	3% Cellulose	97% Other	White Non Fibrous Homogeneous
1200781PLM_6					Dissolved
N-7	Mastic - black	None Detected		100% Other	Black Non Fibrous Homogeneous
1200781PLM_7					Dissolved
N-8	Mastic - black	None Detected		100% Other	Black Non Fibrous Homogeneous
1200781PLM_8					Dissolved

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Bart Huber (32)

Analyst

Nathaniel Durham, MS or Approved Signatory

# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200781

**Analysis ID:** 1200781PLM

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Hanibal Bldg Set N

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
N-9	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200781PLM_9					Crushed
N-10	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200781PLM_10					Crushed
N-11	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200781PLM_11					Crushed
N-12	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200781PLM_12					Crushed
N-13	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200781PLM_13					Crushed
N-14	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200781PLM_14					Crushed
N-15	Mastic - yellow	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200781PLM_15					Dissolved
N-16	Mastic - yellow	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1200781PLM_16					Dissolved

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Bart Huber (32)

Analyst

Nathaniel Durham, MS or Approved Signatory

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888

Page 2 of 4

# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200781

**Analysis ID:** 1200781PLM

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Hanibal Bldg Set N

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
N-17	Drywall / joint compound	< 1% Chrysotile	12% Cellulose	88% Other	Tan, Brown, White Non Fibrous Heterogeneous
1200781PLM_17	<i>drywall: none detect; joint compnd: 3% chrysotile</i>				Crushed
N-18	Drywall / joint compound	< 1% Chrysotile	12% Cellulose	88% Other	Tan, Brown, White Non Fibrous Heterogeneous
1200781PLM_18	<i>drywall: none detect; joint compnd: 3% chrysotile</i>				Crushed
N-19	Mastic - yellow	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Homogeneous
1200781PLM_19					Dissolved
N-20	Mastic - yellow	None Detected	3% Cellulose	97% Other	Yellow Non Fibrous Homogeneous
1200781PLM_20					Dissolved
N-21	Terrazzo flooring	None Detected		100% Other	White Non Fibrous Heterogeneous
1200781PLM_21					Crushed
N-22	Terrazzo flooring	None Detected		100% Other	White Non Fibrous Heterogeneous
1200781PLM_22					Crushed
N-23	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200781PLM_23					Crushed
N-24	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200781PLM_24					Crushed

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Bart Huber (32)

Analyst

Nathaniel Durham, MS or Approved Signatory

# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



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**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200781

**Analysis ID:** 1200781PLM

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Hanibal Bldg Set N

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
N-25	Plaster - skim	None Detected		100% Other	White Non Fibrous Homogeneous
1200781PLM_25					Crushed
N-26	Plaster - base	None Detected	2% Cellulose	98% Other	Gray Non Fibrous Heterogeneous
1200781PLM_26					Crushed
N-27	Window caulk - white	None Detected		100% Other	White Non Fibrous Homogeneous
1200781PLM_27					Dissolved
N-28	Window caulk - white	None Detected		100% Other	White Non Fibrous Homogeneous
1200781PLM_28					Dissolved
N-29	Cove base - black	None Detected		100% Other	Black Non Fibrous Homogeneous
1200781PLM_29					Dissolved
N-30	Cove base - black	None Detected		100% Other	Black Non Fibrous Homogeneous
1200781PLM_30					Dissolved
N-31	Cove base - grey	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200781PLM_31					Dissolved
N-32	Cove base - grey	None Detected		100% Other	Gray Non Fibrous Homogeneous
1200781PLM_32					Dissolved

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Bart Huber (32)

Analyst

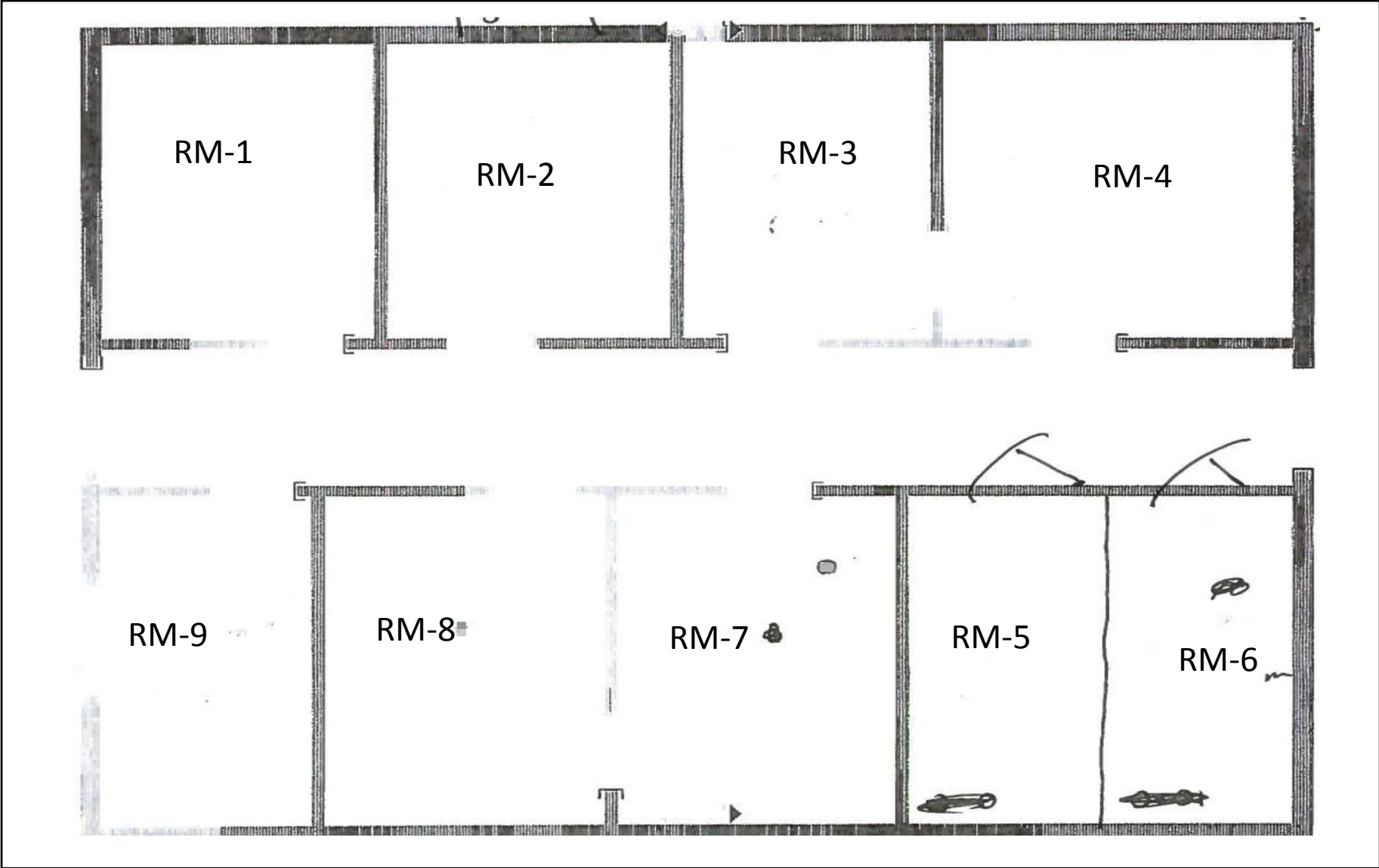
Nathaniel Durham, MS or Approved Signatory



**Lead Sample Datasheet**

<b>Sample Number</b>	<b>Substrate</b>	<b>Component</b>	<b>Color</b>	<b>Location / Description</b>	<b>XRF Reading</b>	<b>LBP (Yor N)</b>
Cal1		SRM - 2579	Red	Calibration Test	1.00	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA
N-1	drywall	wall b	yellow	room 218 B	0.01	no
N-2	metal	door frame	white	room 218 B	0.03	no
N-3	metal	door frame	gray	room 2	0.04	no
N-4	wood	door frame	white	near room 2 hallway	0.00	no
N-5	plaster	wall	tan	room 221	0.02	no
N-6	brick	wall	white	room 222	0.04	no
N-8	concrete	floor	gray	room 222	0.12	no
N-9	metal	door	gray	main stairway to 2nd floor	0.11	no
N-10	drywall	ceiling	cream	under stairway 2nd floor	0.02	no
N-11	plaster	wall d	yellow	Janice office	0.03	no
N-12	wood	door frame	gray	near room 112	0.00	no
N-13	plaster	window sill	yellow	room 103 director office	0.00	no
N-14	brick	wall	white	exterior of building	0.00	no
N-15	metal	railing	gray	exterior of directors office	0.00	no
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA

**(O) LANDFILL SCALE HOUSE**



**Prepared by**  
KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

**Landfill Scale House**  
**Notes:**  
Floor Plan to be used for purpose of this report only

**Prepared for**  
County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
 Phone: 336.292.3888 Fax: 336.292.3313  
 www.sallab.com lab@sallab.com

1200786

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
 Client Code: \_\_\_\_\_

Company Contact Information	
Company: KCI Associates of NC	Contact: Tehsin Aurangabadwala
Address:	Phone <input type="checkbox"/> : 410.891.1726
4601 Six Forks Rd., 220	Fax <input type="checkbox"/> : 410316.7935
Raleigh, NC 27609	Email <input type="checkbox"/> : tehsin@kci.com

Asbestos Test Types	
PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>
Positive stop	<input checked="" type="checkbox"/>
PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AIIERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other:	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY - TAT.

PO Number: \_\_\_\_\_  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 5 sets.			
set L	Sample # L-1 to L-58		
set M	Sample # M-1 to M-31		
Set N	Sample # N-1 to N-32		
Set O	Sample # O-1 to O-11		
Set P	Sample # P-1 to P-13.		
			Accepted <input checked="" type="checkbox"/> Rejected <input type="checkbox"/>
1) Please apply positive stop as indicated on sampling datasheets. 2) Please separate and analyze layers for Floor Tile/Vinyl and Mastics & Plaster samples 3) Please provide separate reports for each set of samples.			

Total # of Samples \_\_\_\_\_

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/16/2012		1-17 10A



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200786

**Analysis ID:** 1200786PLM

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Landfill Scale House  
Set O

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
O-01	Vinyl floor (beige)	None Detected		100% Other	Beige Non Fibrous Homogeneous
1200786PLM_1					Dissolved
O-02	Vinyl floor (beige)	None Detected		100% Other	Beige Non Fibrous Homogeneous
1200786PLM_2					Dissolved
O-03	Spray-on ceiling	None Detected		100% Other	White Non Fibrous Homogeneous
1200786PLM_3					Crushed
O-04	Spray-on ceiling	None Detected		100% Other	White Non Fibrous Homogeneous
1200786PLM_4					Crushed
O-05	Spray-on ceiling	None Detected		100% Other	White Non Fibrous Homogeneous
1200786PLM_5					Crushed
O-06	Spray-on ceiling	None Detected		100% Other	White Non Fibrous Homogeneous
1200786PLM_6					Crushed
O-07	Spray-on ceiling	None Detected		100% Other	White Non Fibrous Homogeneous
1200786PLM_7					Crushed
O-08	SR	None Detected	12% Cellulose	88% Other	Brown, White Non Fibrous Heterogeneous
1200786PLM_8			Crushed		

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Bart Huber (11)

Analyst

Nathaniel Durham, MS or Approved Signatory

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888

Page 1 of 2

# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200786

**Analysis ID:** 1200786PLM

**Date Received:** 1/17/2012

**Project:** 15111236 IHG-00 Landfill Scale House  
Set O

**Date Reported:** 1/23/2012

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
O-09	SR	None Detected	12% Cellulose	88% Other	Brown, White Non Fibrous Heterogeneous
1200786PLM_9					Crushed
O-10	Exterior caulking (white)	None Detected		100% Other	White Non Fibrous Homogeneous
1200786PLM_10					Dissolved
O-11	Exterior caulking (white)	None Detected		100% Other	White Non Fibrous Homogeneous
1200786PLM_11					Dissolved

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Analyst

Nathaniel Durham, MS or Approved Signatory

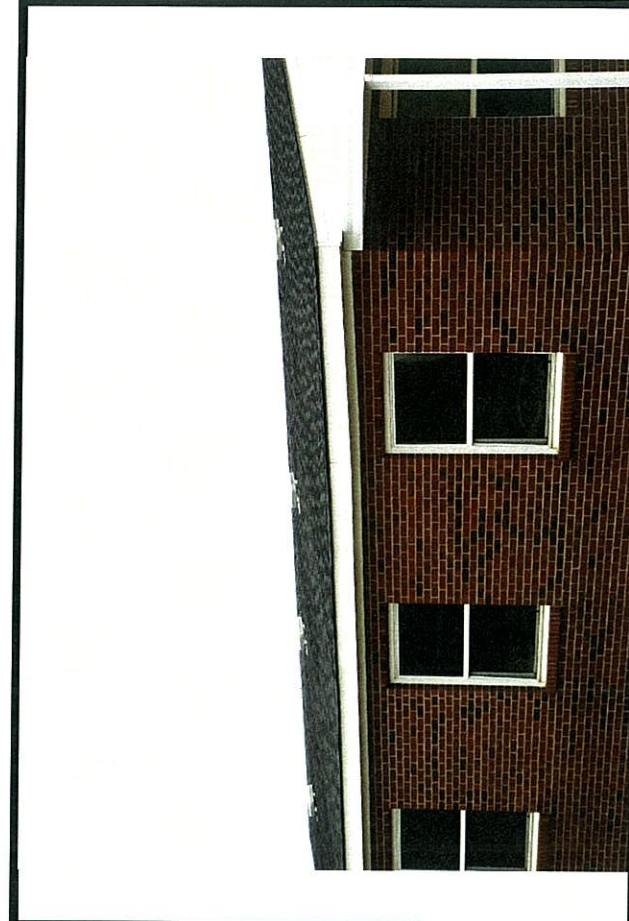
### Lead Sample Datasheet

Sample Number	Substrate	Component	Color	Location / Description	XRF Reading	LBP (Yor N)
Cal1		SRM - 2579	Red	Calibration Test	1.00	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
O-1	wood	door	gray	Room 1	0.10	no
O-2	wood	door frame	gray	Room 1	0.00	no
O-3	wood	door frame	gray	Room 9	0.00	no
O-4	wood	door	gray	Room 9	0.10	no
O-5	wood	door	white	End of hallway	0.00	no
O-6	drywall	wall	light gray	In front of Room 6	0.00	no
O-7	wood	door frame	white	Room 6	0.00	no
O-8	metal	door frame	white	exterior of entrance	0.00	no
O-9	metal	door	gray	exterior of entrance	0.06	no
O-10	metal	window sill	white	exterior of entrance	0.01	no
O-11	metal	window bars	black	side of building near Room 1	0.00	no
O-12	metal	window	yellow	lower of building	0.00	no
O-13	metal	door	gray	exterior back of building	0.06	no
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA





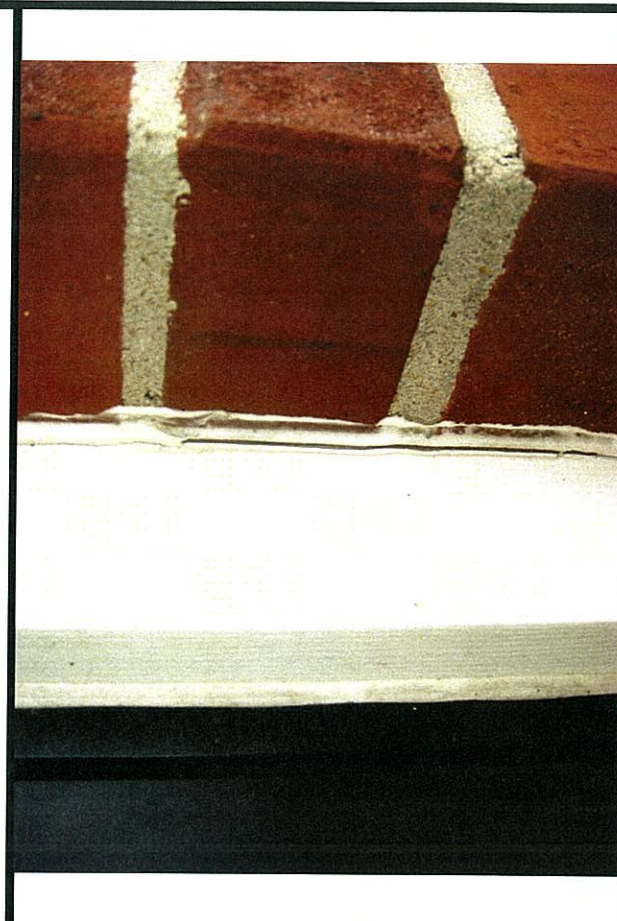
Landfill Scale House



Assumed Roof penetrations and Asphalt shingles

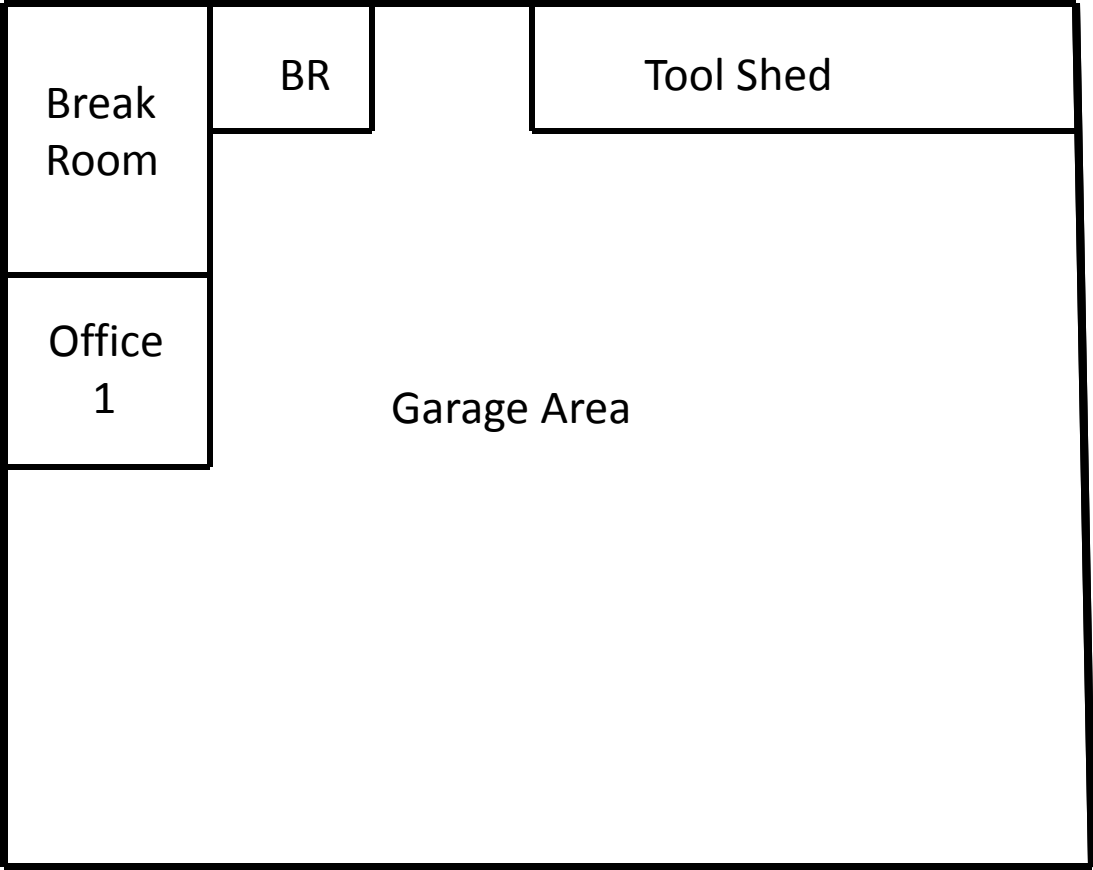


Non Asbestos vinyl flooring in bathrooms



Non Asbestos Caulking around exterior door and windows

**(P) LANDFILL MAINTENANCE BUILDING**



**Prepared by**  
KCI Associates of North Carolina, P.A  
4601 Six Forks Road Landmark Center II, Suite 220  
Raleigh, NC 27609  
KCI Project No: 15111236

**Landfill Scale Maintenance Shop**  
Notes:  
Floor Plan to be used for purpose of this report only

**Prepared for**  
County of Lenoir  
130 South Queen Street,  
Kinston, NC 28502



**Scientific Analytical Institute**  
 302-L Pomona Dr. Greensboro, NC 27407  
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1700784

Lab Use Only  
 Lab Order ID: \_\_\_\_\_  
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4601 Six Forks Rd., 220	Fax ☐: 410316.7935
Raleigh, NC 27609	Email ☐: tehsin@kci.com

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PLM Point Count	<input type="checkbox"/>
PCM NIOSH 7400	<input type="checkbox"/>
TEM AHIERA	<input type="checkbox"/>
TEM Level II	<input type="checkbox"/>
TEM NIOSH 7402	<input type="checkbox"/>
TEM Bulk Qualitative	<input type="checkbox"/>
TEM Bulk Chatfield	<input type="checkbox"/>
TEM Bulk Quantitative	<input type="checkbox"/>
TEM Wipe ASTM D6480-99	<input type="checkbox"/>
TEM Microvac ASTM D5755-02	<input type="checkbox"/>
TEM Water EPA 100.2	<input type="checkbox"/>
Other:	<input type="checkbox"/>

Billing/Invoice Information	Turn Around Times	
Company: KCI Technologies Inc	90 Min. <input type="checkbox"/>	48 Hours <input type="checkbox"/>
Contact: Tehsin Aurangabadwala	3 Hours <input type="checkbox"/>	72 Hours <input type="checkbox"/>
Address:	6 Hours <input type="checkbox"/>	96 Hours <input type="checkbox"/>
936 Ridgebrook Rd	12 Hours <input type="checkbox"/>	120 Hours <input checked="" type="checkbox"/>
Sparks, MD 21152	24 Hours <input type="checkbox"/>	144 Hours <input type="checkbox"/>

5 DAY - TAT.

PO Number: \_\_\_\_\_  
 Project Name/Number: 15111236 IHG-00

Sample ID #	Description/Location	Volume/Area	Comments
See Attached Sampling Datasheets for 5 sets.			
Set L	Sample # L-1 to L-58		
Set M	Sample # M-1 to M-31		
Set N	Sample # N-1 to N-32		
Set O	Sample # O-1 to O-11		
Set P	Sample # P-1 to P-13		
Accepted <input checked="" type="checkbox"/> Rejected <input type="checkbox"/>			
1) Please apply positive stop as indicated on sampling datasheets. 2) Please separate and analyze layers for Floor Tile/Vinyl and Mastics & Plaster samples 3) Please provide separate reports for each set of samples.			

Total # of Samples

Relinquished by	Date/Time	Received by	Date/Time
Tehsin Aurangabadwala	1/16/2012		1-17-10A

1200784



ASBESTOS BULK SAMPLE SHEET

Job Order No: 1511236 Location: Landfill Maintenance Date: 1-9-12  
 Inspector: WILLIAM J. LANE Signature: William J. Lane Page: 1 of 1

Sample No	Type of Material	Location / Description	Friable Yes / No / Potential	Condition Good/ Damaged	Quantity	Remarks
P-01	vinyl floor	office 1		Damaged	126'	} PS
P-02	vinyl floor	office 2		Damaged	126'	
P-03	ceiling tile	Breakroom			140'	
P-04	ceiling tile	Breakroom			140'	
P-05	spray on insulation	shop area				
P-06						
P-07						
P-08						
P-09						
P-10						
P-11						
P-12	Ext. Caulking	windows & Doors				
P-13	Ext. Caulking	windows & Doors				

# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
4601 Six Forks Rd, 220  
Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200784

**Analysis ID:** 1200784PLM

**Date Received:** 1/17/2012

**Date Reported:** 1/23/2012

**Project:** 15111236 IHG-00 Landfill Maintenance  
Set P

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
P-01	Vinyl floor	None Detected	15% Cellulose 10% Fiber Glass	75% Other	White Non Fibrous Homogeneous
1200784PLM_1					Dissolved, Teased
P-02	Vinyl floor	None Detected	15% Cellulose 10% Fiber Glass	75% Other	White Non Fibrous Homogeneous
1200784PLM_2					Dissolved, Teased
P-03	Ceiling tile	None Detected	95% Cellulose	5% Other	Gray, Brown Non Fibrous Homogeneous
1200784PLM_3					Teased
P-04	Ceiling tile	None Detected	95% Cellulose	5% Other	Gray, Brown Non Fibrous Homogeneous
1200784PLM_4					Teased
P-05	Spray-on insulation	None Detected	95% Fiber Glass	5% Other	White Fibrous Homogeneous
1200784PLM_5					Teased
P-06	Spray-on insulation	None Detected	95% Fiber Glass	5% Other	White Fibrous Homogeneous
1200784PLM_6					Teased
P-07	Spray-on insulation	None Detected	95% Fiber Glass	5% Other	White Fibrous Homogeneous
1200784PLM_7					Teased
P-08	Spray-on insulation	None Detected	95% Fiber Glass	5% Other	White Fibrous Homogeneous
1200784PLM_8					Teased

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Bart Huber (13)

Analyst

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Page 1 of 2

# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** KCI Associates of NC  
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Raleigh, NC 27609

**Attn:** Tehsin Aurangabadwala

**Lab Order ID:** 1200784

**Analysis ID:** 1200784PLM

**Date Received:** 1/17/2012

**Date Reported:** 1/23/2012

**Project:** 15111236 IHG-00 Landfill Maintenance  
Set P

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
P-09	Spray-on insulation	None Detected	95% Fiber Glass	5% Other	White Fibrous Homogeneous
1200784PLM_9					Teased
P-10	Spray-on insulation	None Detected	95% Fiber Glass	5% Other	White Fibrous Homogeneous
1200784PLM_10					Teased
P-11	Spray-on insulation	None Detected	95% Fiber Glass	5% Other	White Fibrous Homogeneous
1200784PLM_11					Teased
P-12	Ext caulking	None Detected		100% Other	White Non Fibrous Homogeneous
1200784PLM_12					Dissolved
P-13	Ext caulking	None Detected		100% Other	White Non Fibrous Homogeneous
1200784PLM_13					Dissolved

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**Lead Sample Datasheet**

<b>Sample Number</b>	<b>Substrate</b>	<b>Component</b>	<b>Color</b>	<b>Location / Description</b>	<b>XRF Reading</b>	<b>LBP (Yor N)</b>
Cal1		SRM - 2579	Red	Calibration Test	1.00	NA
Cal2		SRM - 2579	Red	Calibration Test	1.00	NA
Cal3		SRM - 2579	Red	Calibration Test	1.00	NA
P-1	metal	siding	white	exterior of main entrance	0.00	no
P-2	metal	door	white	exterior door	0.00	no
P-3	metal	door	white	door of entrance	0.20	no
P-4	wood	wall b	white	near tool shed	0.00	no
P-5	wood	door frame	white	near tool shed	0.00	no
P-6	concrete	floor	gray	bathroom	0.10	no
P-7	wood	wall d	white	bathroom	0.01	no
P-8	wood	wall	gray	break room	0.00	no
P-9	wood	door frame	gray	break room	0.11	no
P-10	wood	ceiling	white	office 1	0.04	no
P-11	wood	window sill	tan	office 1	0.00	no
P-12	wood	wall	red	near back of garage	0.00	no
P-13	concrete	floor	yellow	near back of garage	0.00	no
Cal1		SRM - 2579	Red	Calibration Test	1.10	NA
Cal2		SRM - 2579	Red	Calibration Test	1.10	NA
Cal3		SRM - 2579	Red	Calibration Test	1.10	NA





Landfill Maintenance Building Spray Applied Insulation



Non Asbestos spray applied insulation on wall and ceiling throughout



Landfill Maintenance Building Roof



Non Asbestos Vinyl flooring in Office 1



SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product, including panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate, and cabinet hardware and accessories.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples:
  1. Plastic laminates, for each color, pattern, and surface finish.

1.3 INFORMATIONAL SUBMITTALS

- A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates or WI Certified Compliance Program certificates.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program or Licensee of WI's Certified Compliance Program.
- B. Installer Qualifications: Fabricator of products; Certified participant in AWI's Quality Certification Program or Licensee of WI's Certified Compliance Program.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

- A. Fabricators: Subject to compliance with requirements, available fabricators offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Basepoint Millwork, Forbes Millwork, Over the Counter Millwork, or Stephenson Millwork.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
- B. Grade: Custom.
- C. Regional Materials: Plastic-laminate cabinets shall be manufactured within 500 miles (800 km) of Project site.
- D. Type of Construction: Frameless.
- E. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- F. Reveal Dimension: 1/2 inch (13 mm).
- G. Edge banding: 3mm PVC on cabinet doors and drawers, 1mm PVC on cabinet body fronts.
- H. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Wilsonart International; Div. of Premark International, Inc.
    - b. Formica Corporation.
    - c. Lamin-Art, Inc.
    - d. Panolam Industries International, Inc.
- I. Laminate Cladding for Exposed Surfaces:
  - 1. Horizontal Surfaces: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade VGS.
  - 4. Pattern Direction: Vertically for doors and fixed panels, horizontally for drawer fronts.
- J. Materials for Semiexposed Surfaces:
  - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
  - 2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
  - 3. Drawer Bottoms: Thermoset decorative panels.

- K. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- L. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. Plastic laminate cabinet bodies: Wilsonart / Grey / 1500-60
  - 2. Plastic laminate countertops: Wilsonart / Canyon Zephyr 4842-60

### 2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
  - 1. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  - 2. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

### 2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
- D. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.
- E. Catches: Magnetic catches, BHMA A156.9, B03141.
- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112. OR line boring system with polycarbonate double pin locking shelf clips.
- G. Drawer Slides: BHMA A156.9.
  - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
  - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.

3. For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
4. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-100.
5. For computer keyboard shelves, provide Grade 1.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Door and Drawer Silencers: BHMA A156.16, L03011.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

## 2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement or PVA.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.6 FABRICATION

A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

C. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
- E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
  - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

END OF SECTION 064116

SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal frames.
- B. Related Requirements:
  - 1. Section 081416 "Flush Wood Doors" for wood doors installed in hollow-metal frames.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
  - 1. Amweld International, LLC.
  - 2. Apex Industries, Inc.
  - 3. Ceco Door Products; an Assa Abloy Group company.
  - 4. Commercial Door & Hardware Inc.
  - 5. Concept Frames, Inc.
  - 6. Curries Company; an Assa Abloy Group company.
  - 7. Custom Metal Products.
  - 8. Daybar.
  - 9. Deansteel.

10. DKS Steel Door & Frame Sys. Inc.
11. Door Components, Inc.
12. Fleming-Baron Door Products.
13. Gensteel Doors Inc.
14. Greensteel Industries, Ltd.
15. HMF Express.
16. Hollow Metal Inc.
17. Hollow Metal Xpress.
18. Karpen Steel Custom Doors & Frames.
19. L.I.F. Industries, Inc.
20. LaForce, Inc.
21. Megamet Industries, Inc.
22. Mesker Door Inc.
23. Michbi Doors Inc.
24. MPI Group, LLC (The).
25. National Custom Hollow Metal.
26. North American Door Corp.
27. Philipp Manufacturing Co (The).
28. Pioneer Industries, Inc.
29. Premier Products, Inc.
30. Republic Doors and Frames.
31. Security Metal Products Corp.
32. Steelcraft; an Ingersoll-Rand company.
33. Steward Steel; Door Division.
34. Stiles Custom Metal, Inc.
35. Titan Metal Products, Inc.

## 2.2 INTERIOR FRAMES

- A. Standard-Duty Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule
  1. Physical Performance: Level C according to SDI A250.4.
  2. Materials: Uncoated cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
  3. Construction: Full profile welded.
  4. Exposed Finish: Prime.
- B. Fire-Rated Door Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
  1. Provide frame labels from manufacturer indicating compliance with the required fire rating certification and matching the fire rating performance of the applicable door.
  2. Prevent installed fire rated labels from being obscured by paint or other construction components.

## 2.3 FRAME ANCHORS

- A. Jamb Anchors:
  1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.



- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

## 2.4 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).

## 2.5 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c.
    - b. Compression Type: Not less than two anchors in each frame.
  - 5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce frames to receive nontemplated, mortised, and surface-mounted hardware.

2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- D. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior frames.
  4. Provide loose stops and moldings on inside of hollow-metal work.
  5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

## 2.6 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: SDI A250.10.
- B. Factory Finish: SDI A250.3.
1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
  2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
  4. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
  5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- B. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

### 3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

SECTION 81416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.

B. Related Sections:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door indicated. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

C. Samples: For factory-finished doors.

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Algoma Hardwoods, Inc.
  2. Buell Door Company Inc.
  3. Chappell Door Co.
  4. Eggers Industries.
  5. Masonite Architectural

2.2 DOOR CONSTRUCTION, GENERAL

- A. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- B. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. WDMA I.S.1-A Performance Grade:
1. Heavy Duty unless otherwise indicated.
  2. Extra Heavy Duty: public toilets, janitor's closets, exits, patient rooms.
- D. Structural-Composite-Lumber-Core Doors:
1. Structural Composite Lumber: WDMA I.S.10.
    - a. Screw Withdrawal, Face: Manufacturer's standard.
    - b. Screw Withdrawal, Edge: Manufacturer's standard.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors (SCW):
1. Grade: Premium, with Grade A faces.
  2. Species: Natural Birch
  3. Cut: Rotary sliced
  4. Match between Veneer Leaves: Book match.
  5. Assembly of Veneer Leaves on Door Faces: Balance match.
  6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
  7. Core: Either glued wood stave or structural composite lumber.
  8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  - 1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Cut and trim openings through doors in factory.
  - 1. Light Openings: Trim openings with moldings of material and profile indicated.
  - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Transparent Finish:
  - 1. Grade: Premium.
  - 2. Finish: WDMA TR-4 conversion varnish or TR-6 catalyzed polyurethane.
  - 3. Staining: Cocoa Bean.
  - 4. Effect: Filled finish.
  - 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
  
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
  
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 81416

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
  - 1. Mechanical door hardware for the following:
    - a. Swinging doors.
  - 2. Cylinders for door hardware specified in other Sections.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Details of electrified door hardware.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Other Action Submittals:
  - 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
    - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
    - b. Content: Include the following information:
      - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
      - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
      - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
      - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
  - 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks, and matching Owner's existing keying schedule.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the



course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

- B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- C. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC/ANSI A117.1, HUD's "Fair Housing Accessibility Guidelines" and NC Building Code.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
  - 2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
  - 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- E. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- B. Deliver keys to Owner.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
    - a. Electromagnetic Locks: Five years from date of Substantial Completion.
    - b. Exit Devices: Two years from date of Substantial Completion.
    - c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled to comply with requirements in this Section.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
  - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
  - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
  - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

- A. Hinges: BHMA A156.1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Baldwin Hardware Corporation.
    - b. Bommer Industries, Inc.
    - c. Cal-Royal Products, Inc.
    - d. Hager Companies.
    - e. IVES Hardware; an Ingersoll-Rand company.
    - f. Lawrence Hardware Inc.
    - g. McKinney Products Company; an ASSA ABLOY Group company.
    - h. PBB, Inc.
    - i. Stanley Commercial Hardware; Div. of The Stanley Works.

2.3 MECHANICAL LOCKS AND LATCHES

- A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  - 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
  - 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- B. Bored Locks: BHMA A156.2; Grade 1 Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Arrow USA; an ASSA ABLOY Group company.
  - b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
  - c. Cal-Royal Products, Inc.
  - d. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
  - e. Falcon Lock; An Ingersoll-Rand Company.
  - f. K2 Commercial Hardware; a Black & Decker Corp. company.
  - g. Marks USA.
  - h. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
  - i. PDQ Manufacturing.
  - j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
  - k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
  - l. Weiser Lock Corp.; a Black & Decker Corp. company.
  - m. Yale Security Inc.; an ASSA ABLOY Group company.

#### 2.4 AUXILIARY LOCKS

- A. Bored Auxiliary Locks: BHMA A156.5: Grade 1 with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Arrow USA; an ASSA ABLOY Group company.
  - b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
  - c. Cal-Royal Products, Inc.
  - d. Falcon Lock; an Ingersoll-Rand company.
  - e. Hager Companies.
  - f. K2 Commercial Hardware; a Black & Decker Corp. company.
  - g. Marks USA.
  - h. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
  - i. PDQ Manufacturing.
  - j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
  - k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
  - l. Weiser Lock Corp.; a Black & Decker Corp. company.
  - m. Yale Security Inc.; an ASSA ABLOY Group company.

- B. Push-Button Combination Locks: BHMA A156.5; cylindrical; Grade 1; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Kaba Ilco Corp.; a Kaba Group company.

#### 2.5 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
  - b. Arrow USA; an ASSA ABLOY Group company.
  - c. Cal-Royal Products, Inc.
  - d. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
  - e. Detex Corporation.
  - f. Door Controls International, Inc.
  - g. DORMA Architectural Hardware; Member of The DORMA Group North America.
  - h. Dor-O-Matic; an Ingersoll-Rand company.
  - i. K2 Commercial Hardware; a Black & Decker Corp. company.
  - j. Monarch Exit Devices & Panic Hardware; an Ingersoll-Rand company.
  - k. Precision Hardware, Inc.; Division of Stanley Security Solutions, Inc.
  - l. Rutherford Controls Int'l. Corp.
  - m. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
  - n. Von Duprin; an Ingersoll-Rand company.
  - o. Yale Security Inc.; an ASSA ABLOY Group company.

## LOCK CYLINDERS

- B. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
  1. Manufacturer: Same manufacturer as for locking devices.
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Arrow USA; an ASSA ABLOY Group company.
    - b. ASSA, Inc.; An ASSA ABLOY Group Company.
    - c. Best Access Systems; Div. of Stanley Security Solutions, Inc.
    - d. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
    - e. Falcon Lock; an Ingersoll-Rand company.
    - f. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
    - g. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
    - h. Schlage Commercial Lock Division; an Ingersoll-Rand company.
    - i. Yale Security Inc.; an ASSA ABLOY Group company.

- C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

## 2.6 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
  1. No Master Key System: Only change keys operate cylinder.
  2. Master Key System: Change keys and a master key operate cylinders.
  3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
  4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.

5. Existing System:
  - a. Master key or grand master key locks to Owner's existing system.
  - b. Re-key Owner's existing master key system into new keying system.
6. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver.

1. Quantity: In addition to one extra key blank for each lock, provide the following:
  - a. Cylinder Change Keys: Three.
  - b. Master Keys: Five.
  - c. Grand Master Keys: Five.
  - d. Great-Grand Master Keys: Five.

## 2.7 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Arrow USA; an ASSA ABLOY Group company.
  - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
  - c. DORMA Architectural Hardware; Member of The DORMA Group North America.
  - d. Dor-O-Matic; an Ingersoll-Rand company.
  - e. K2 Commercial Hardware; a Black & Decker Corp. company.
  - f. LCN Closers; an Ingersoll-Rand company.
  - g. Norton Door Controls; an ASSA ABLOY Group company.
  - h. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
  - i. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
  - j. Yale Security Inc.; an ASSA ABLOY Group company.

## 2.8 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Baldwin Hardware Corporation.
  - b. Burns Manufacturing Incorporated.
  - c. Don-Jo Mfg., Inc.
  - d. Hiawatha, Inc.
  - e. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation.
  - f. IVES Hardware; an Ingersoll-Rand company.

- g. Pawling Corporation.
- h. Rockwood Manufacturing Company.
- i. Trimco.

## 2.9 AUXILIARY DOOR HARDWARE

### A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Baldwin Hardware Corporation.
  - b. Cal-Royal Products, Inc.
  - c. Don-Jo Mfg., Inc.
  - d. Hager Companies.
  - e. Rockwood Manufacturing Company.
  - f. Stanley Commercial Hardware; Div. of The Stanley Works.
  - g. Trimco.

## 2.10 FABRICATION

### A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:
  - a. Wood or Machine Screws: For the following:
    - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
    - 2) Strike plates to frames.
    - 3) Closers to doors and frames.
  - b. Steel Through Bolts: For the following unless door blocking is provided:
    - 1) Surface hinges to doors.
    - 2) Closers to doors and frames.
    - 3) Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.11 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- C. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- F. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- G. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

- I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- M. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

END OF SECTION 087100



SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - A. Windows.
  - B. Doors.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
  - A. Design Wind Pressures: As indicated on Drawings.
  - B. Design Snow Loads: As indicated on Drawings.
  - C. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
  - D. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

1.3 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - A. GANA Publications: GANA's "Laminated Glazing Reference Manual"
  - B. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
  - C. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."

- D. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

## 1.5 WARRANTY

- A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - A. Warranty Period: ten years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - A. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  - B. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  - C. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

### 2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent.

A. Products: Subject to compliance with requirements, provide one of the following:

- a. AFG Industries, Inc.; Krystal Klear.
- b. Guardian Industries Corp.; Ultrawhite.
- c. Pilkington North America; Optiwhite.
- d. PPG Industries, Inc.; Starphire.

C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

### 2.3 INSULATING GLASS

A. Products: Subject to compliance with requirements, provide one of the following:

- a. AFG Industries, Inc.
- b. Cardinal Glass Industries
- c. Pilkington North America
- d. PPG Industries, Inc
- e. Oldcastle

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

A. Sealing System: Dual seal.

B. Spacer: Manufacturer's standard spacer material and construction

### 2.4 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

- A. Neoprene complying with ASTM C 864.
- B. EPDM complying with ASTM C 864.
- C. Silicone complying with ASTM C 1115.
- D. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

A. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

### 2.5 GLAZING SEALANTS

A. General:

A. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

- B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  - C. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - D. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  - E. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

## 2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
  - A. AAMA 804.3 tape, where indicated.
  - B. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - C. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  - A. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  - B. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.7 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

- F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.8 MONOLITHIC-GLASS TYPES

- A. Glass Type: Clear float glass & fully tempered float glass (where noted) and Countertop Modesty Glass Panel (Clear fully tempered float glass).
  - A. Thickness: 6.0 mm
  - B. Provide safety glazing labeling.

2.9 INSULATING-GLASS TYPES

- A. Glass Type: Low-e-coated, tinted insulating glass.
  - A. Overall Unit Thickness: 1 inch
  - B. Thickness of Each Glass Lite: 6.0 mm
  - C. Outdoor Lite: Tinted float glass or fully tempered float glass.
  - D. Interspace Content: Air.
  - E. Indoor Lite: Clear float glass or fully tempered float glass.
  - F. Low-E Coating: Pyrolytic on second surface.
  - G. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches

- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### 3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Gypsum.
  2. CertainTeed Corp.
  3. Georgia-Pacific Gypsum LLC.
  4. Lafarge North America Inc.
  5. National Gypsum Company.
  6. PABCO Gypsum.



7. Temple-Inland.
8. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered or Tapered and featured (rounded or beveled) for prefilling.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
  - a. Cornerbead.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. L-Bead: L-shaped; exposed long flange receives joint compound.
  - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
  - e. Expansion (control) joint.

## 2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
  - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.

4. Finish Coat: For third coat, use setting-type, sandable topping compound.

## 2.6 AUXILIARY MATERIALS

- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).
- D. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
    - b. Grabber Construction Products; Acoustical Sealant GSC.
    - c. Pecora Corporation.
    - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
    - e. USG Corporation; SHEETROCK Acoustical Sealant.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- F. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

## PART 3 - EXECUTION

### 3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
  1. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- D. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- E. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- F. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

- a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- G. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- H. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical tiles and concealed suspension systems for ceilings.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project Site.
- B. If needed, insert list of conference participants not mentioned in Section 013100 "Project Management and Coordination."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Evaluation reports.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
  - 2. Smoke-Developed Index: 50 or less.

## 2.2 ACOUSTICAL TILE CEILINGS, GENERAL

- A. Low-Emitting Materials: Acoustical tile ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 35% percent.
- C. Acoustical Tile Standard: Comply with ASTM E 1264.
- D. Metal Suspension System Standard: Comply with ASTM C 635.
- E. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- F. Source Limitations:
  - 1. Acoustical Ceiling Tile: Obtain each type from single source from single manufacturer.
  - 2. Suspension System: Obtain each type from single source from single manufacturer.

## 2.3 ACOUSTICAL TILES (ACT)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated: USG Radar High-NRC Panels or comparable product by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corp.
  - 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Classification: Provide tiles complying with ASTM E 1264 for type, form, and pattern as follows:
  - 1. Type: Type III, mineral base with membrane faced overlay
  - 2. Form: Form 2, water felted
  - 3. Pattern: CE
- C. Color: White
- D. LR: Not less than 0.84.
- E. NRC: Not less than 0.70, Type E-400 mounting according to ASTM E 795.
- F. CAC: Not less than 35.
- G. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
- H. Sag Resistance: Provide acoustical tiles treated with manufacturer's standard humidity protection that resists sagging due to high humidity conditions up to, but not including, standing water and outdoor conditions.

- I. Durability: Washable (ASTM D4828)
- J. Edge/Joint Detail: Tegular edge.
- K. Thickness: 3/4 inch (19 mm).
- L. Modular Size: 24 by 24 inches.

#### 2.4 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements provide product indicated on drawings by: USG DX Suspension grid or comparable product by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. USG Interiors, Inc.; Subsidiary of USG Corporation.
  - 3. CertainTeed Corp.
- B. Color: White
- C. Size: 15/16"
- D. Structural Classification: Intermediate-duty system.
- E. Access: Upward.
- F. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install acoustical tile ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.
- C. Arrange directionally patterned acoustical tiles as indicated on reflected ceiling plans.

END OF SECTION 095123

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Resilient base.
  - 2. Resilient stair accessories
  - 3. Resilient molding accessories

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE (R)

- A. Resilient Base:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Johsonite Duracove Thermoplastic Rubber base** or comparable product by one of the following:
    - a. Flexco, Inc.

- b. Johnsonite.
  - c. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.
- 1. Material Requirement: Type TP (rubber, thermoplastic)
  - 2. Manufacturing Method: Group I (solid, homogeneous).
  - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch (3.2 mm).
- D. Height: 6 inches (102 mm).
- E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.
- H. Finish: Smooth Matte.
- I. Colors and Patterns: Pebble #32

## 2.2 RESILIENT STAIR ACCESSORIES

- A. Resilient Stair Treads:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flexco, Inc.
    - b. Johnsonite.
    - c. Roppe Corporation, USA.
- B. Resilient Stair Treads Standard: ASTM F 2169.
- 1. Material Requirement: Type TP (rubber, thermoplastic)
  - 2. Surface Design:
    - a. Class 2, Pattern: Raised-disc design.
- C. Nosing Style: Square.
- D. Nosing Height: 2 inches (51 mm)
- E. Thickness: 1/4 inch (6 mm) and tapered to back edge.
- F. Size: Lengths and depths to fit each stair tread in **one piece**.
- G. Risers: Smooth, flat, **coved-toe, 7 inches (178 mm) high by length matching treads**; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- 1. Thickness: 0.125 inch



- H. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- I. Colors and Patterns: Pebble #32.

### 2.3 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:
  - 1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
    - a. Flexco, Inc.
    - b. Johnsonite.
    - c. Roppe Corporation, USA.
- B. Description: Reducer strip for resilient floor covering, Joiner for tile and carpet, transition strips.
- C. Material: Rubber.
- D. Colors and Patterns: Pebble #32

### 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
  - 4. Moisture Testing: Perform tests recommended by manufacturer.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
- C. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular, tufted carpet tile.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.8 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

1.9 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
  - 3. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (**CPT**)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ShawContract, Arrange Tile (5T294) or comparable product by one of the following:
  - 1. Mohawk Group
  - 2. Shaw Contract
  - 3. J & J Flooring
  - 4. Milliken
  - 5. Mannington
- B. Color: Shiny Pebble 94761
- C. Pattern Repeat: None
- D. Fiber Type: Nylon
- E. Dye Method: 100% Solution dyed
- F. Pile Characteristic: Multi-level patterned loop
- G. Finished Pile Thickness: 0.121 inches
- H. Stitches: 10 stitches per inch
- I. Gauge: 1/10 per inch
- J. Tufted Weight: 16.0 oz./sq. yd.
- K. Primary Backing/Backcoating: Synthetic.
- L. Secondary Backing: Manufacturer's standard material.
- M. Size: 24 by 24 inches (610 by 610 mm).
- N. Applied Soil-Resistance Treatment: Manufacturer's soil protection.

## 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
  - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Preparation: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- E. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- F. Installation Method: **Quarter Turn**.
- G. Maintain dye lot integrity. Do not mix dye lots in same area.
- H. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- I. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- J. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- K. Install pattern parallel to walls and borders.
- L. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  2. Remove yarns that protrude from carpet tile surface.
  3. Vacuum carpet tile using commercial machine with face-beater element.
- M. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

END OF SECTION 096813

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Steel.
  - 2. Gypsum board.

1.2 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.



1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Benjamin Moore & Co. (Benjamin Moore)
  - 2. Glidden Professional (Glidden).
  - 3. Sherwin-Williams Co. (Sherwin-Williams).

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Colors:
  - 1. Walls: Sherwin Williams Wordly Gray 245-C1
  - 2. Door Frames: Sherwin Williams Intellectual Gray 245-C3

2.3 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: MPI #50 (Gypsum board walls)
  - 1. Benjamin Moore: Super Spec, Latex Enamel Undercoater & Primer Sealer 253
  - 2. Glidden: 1000 High-Hide Primer Sealer
  - 3. Sherwin Williams: ProMar 200 Interior Latex Primer

2.4 METAL PRIMERS

- A. Primer, Rust-Inhibitive, Water Based: MPI #107 (Hollow Metal door frames)
  - 1. Benjamin Moore: Super Spec HP, Acrylic Metal Primer P04
  - 2. Glidden: Devflex 4020PF Direct-to-Metal Primer
  - 3. Sherwin Williams: All surface enamel primer

2.5 WATER-BASED PAINTS

- A. Latex, Interior, (Gloss Level 2): MPI #44 (Gypsum board walls)
  - 1. Benjamin Moore: Super Spec, Interior Latex Eggshell Finish C274
  - 2. Glidden: Diamond 350 Interior Eggshell Paint 1403
  - 3. Sherwin Williams: ProMar 200 Interior Latex Eg-Shell B20W2200
- B. Latex, Interior, (Gloss Level 3): MPI #52 (Hollow Metal door frames)
  - 1. Benjamin Moore: Super Spec, Interior Latex Semi-gloss Finish C276
  - 2. Glidden: Diamond 350 Interior Semi-gloss Paint 1407
  - 3. Sherwin Williams: ProMar 200 Interior Alkyd Semi-Gloss B34-2200

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
  - 1. Latex over Alkyd Primer System:
    - a. Prime Coat (1 coat): Primer, Rust-Inhibitive, Water Based: MPI #107
    - b. Topcoat (2 coats): Latex, interior, (Gloss Level 3), MPI #52.
- B. Gypsum Board Substrates:

1. Latex System:
  - a. Prime Coat (1 coat): Primer sealer, latex, interior, MPI #50.
  - b. Topcoat (2 coats): Latex, interior, (Gloss Level 2), MPI #44.

END OF SECTION 099123

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Tested to meet ASTM E84, Class B spread/smoke developed rating.
  - 2. Material Fire ratings:
    - a. National Fire Protection Association (NFPA) 286: Pass
    - b. International Code Council (ICC): Class B
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

## PART 2 - PRODUCTS

## 2.1 SOLID-POLYMER UNITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **Scranton Products, Hiny Hiders, HDPE Partitions**, or comparable product by one of the following:
1. Accurate Partitions Corporation.
  2. Bradley Corporation; Mills Partitions.
  3. General Partitions Mfg. Corp.
  4. Partition Systems Incorporated of South Carolina.
  5. Scranton Products
- C. Toilet-Enclosure Style: Overhead braced Floor anchored.
- D. Urinal-Screen Style: Wall hung
- E. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.
1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
  2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
  3. Polymer Panel Finish: One color and pattern in each room.
    - a. Color and Pattern: Orange Peel texture, Color – As selected from manufacturer's standard colors.
- F. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
1. Polymer Color and Pattern: Matching pilaster
- G. Brackets (Fittings):
1. Stirrup Type: Ear or U-brackets, stainless steel
  2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

## 2.2 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
1. Material: Stainless steel
  2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees
  3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
  5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
  6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

### 2.3 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
- B. Clearances: Maximum 1/2 inch (13 mm) between pilasters and panels; 1 inch (25 mm) between panels and walls.
- C. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

### 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

SECTION 102800 – TOILET ROOM ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Public-use washroom accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.
  - 2. Identify products using designations indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. A & J Washroom Accessories, Inc.
  - 2. American Specialties, Inc.
  - 3. Bobrick Washroom Equipment, Inc.



4. Bradley Corporation.
  5. GAMCO Specialty Accessories: a division of Bobrick Washroom Equipment, Inc.
  6. Tubular Specialties Manufacturing, Inc.
- B. Toilet Tissue (Roll) Dispenser: Twin 9" Jumbo roll dispenser, surface mounted – American Specialties 00400 or equal.
- C. Paper Towel (Folded) Dispenser: Combination Paper Towel dispenser and waste receptacle surface mounted – American Specialties 0469-9 or equal.
- D. Soap Dispensers: Wall Mounted, Automatic Liquid dispenser – American Specialties 0360 or equal.
- E. Napkin Disposal: ADA compliant, surface mounted, stainless steel, sanitary waste receptacle – American Specialties 20852 or equal.
- F. Baby Changing Station: ADA complaint, surface mounted, ABS plastic – American Specialties 9014 or equal.
- G. Grab Bar:
1. Product: ADA Compliant wall mounted grab bars.
  2. Mounting: Flanges with concealed fasteners.
  3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
    - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
  4. Outside Diameter: 1-1/2 inches (38 mm).
  5. Configuration and Length: As indicated on Drawings.
- H. Mirror Unit (**M1**)
1. Product: Wall mounted mirrors.
  2. Frame: Stainless steel, full frame.
    - a. Corners: Welded and ground smooth.
  3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
    - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
    - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
  4. Size: As indicated on Drawings.
- I. Mirror Unit (**M2**)
1. Product: Wall mounted mirrors.
  2. Frame: Framless.
  3. Size: 36" high by width of counter

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

**END OF SECTION 10280**

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-surface-material countertops and backsplashes.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples: For each type of material exposed to view.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Installer Qualifications: An entity that employs installers and supervisors who are approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver no components to project site until areas are ready for installation.

B. Store Components indoors prior to installation.

C. Handle materials to prevent damage to finished surfaces.

1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

A. Configuration: Provide countertops with the following front and backsplash style:

1. Front: Straight, slightly eased at top and bottom.
  2. Backsplash: Straight, slightly eased at corner.
  3. Endsplash: Matching backsplash.
- B. Countertops: 1/2-inch- (12.7-mm) thick, solid surface material with front edge built up with same material.
- C. Backsplashes: 1/2-inch- (12.7-mm) thick, solid surface material, Integral to counter
- D. Sidesplashes: 1/2" inch – (12.7-mm) thick, solid surface material, field applied
- E. Sink Bowls: Integral to counter

## 2.2 COUNTERTOP MATERIALS

- A. Certified Wood Materials: Fabricate countertops with wood and wood-based products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Composite Wood and Agrifiber Products: Provide products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
- D. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Du Pont, Corian
    - b. LG Chemical, Ltd., Hi-Macs
    - c. Samsung Chemical USA, Inc., Staron
    - d. Wilsonart
  2. Type: Provide Standard Type unless Special Purpose Type is indicated.
  3. Colors and Patterns: As indicated on Drawings.

## 2.3 ACCESSORIES

- A. Joint adhesive: Manufacturer's standard one or two part adhesive kit to create inconspicuous, nonporous joints.

- B. Sealant: Manufacturer's standard mildew-resistant, FDA-compliant, UL-listed silicone sealant in colors matching components.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

**END OF SECTION 123661**

**SECTION 220513****COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

**1.02 COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

**PART 2 - PRODUCTS****2.01 GENERAL MOTOR REQUIREMENTS**

- A. Comply with NEMA MG 1 unless otherwise indicated.

**2.02 MOTOR CHARACTERISTICS**

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

**2.03 POLYPHASE MOTORS**

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.

- H. Insulation: Class F.
- I. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

#### **2.04 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS**

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
  - 2. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

#### **2.05 SINGLE-PHASE MOTORS**

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

### **PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 220513**

**SECTION 220516****EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Alignment guides and anchors.
  - 2. Pipe loops and swing connections.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

**1.04 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.05 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

**2.02 ALIGNMENT GUIDES AND ANCHORS**

- A. Alignment Guides:



1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.
- B. Anchor Materials:
1. Steel Shapes and Plates: ASTM A36/A36M.
  2. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
  3. Washers: ASTM F844, steel, plain, flat washers.
  4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
    - a. Stud: Threaded, zinc-coated carbon steel.
    - b. Expansion Plug: Zinc-coated steel.
    - c. Washer and Nut: Zinc-coated steel.
  5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
    - a. Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    - b. Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
    - c. Washer and Nut: Zinc-coated steel.

### **PART 3 - EXECUTION**

#### **3.01 EXPANSION JOINT INSTALLATION**

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

#### **3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION**

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

#### **3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION**

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.

- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
  - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

**END OF SECTION 220516**

**SECTION 220517****SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Grout.
  - 4. Silicone sealants.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**PART 2 - PRODUCTS****2.01 SLEEVES**

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

**2.02 SLEEVE-SEAL SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. GPT; an EnPro Industries company.
  - 3. Metraflex Company (The).
- B. Description:
  - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 2. Designed to form a hydrostatic seal of 20 psig minimum.
  - 3. Sealing Elements: EPDM-rubber or High-Temperature Silicone with interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 4. Pressure Plates: Composite plastic or Stainless steel, Type 316.

5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 or Stainless steel, Type 316 of length required to secure pressure plates to sealing elements.

### 2.03 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

### 2.04 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Sherwin-Williams Company (The).
    - c. The Dow Chemical Company.

## PART 3 - EXECUTION

### 3.01 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide required annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

**3.02 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

**3.03 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

**3.04 SLEEVE AND SLEEVE-SEAL SCHEDULE**

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron or steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron or steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron or steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves.
  - 5. Interior Partitions:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

**END OF SECTION 220517**

**SECTION 220518****ESCUTCHEONS FOR PLUMBING PIPING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**PART 2 - PRODUCTS****2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. BrassCraft Manufacturing Co.; a Masco company.
  - 2. Dearborn Brass.
  - 3. Keeney Manufacturing Company (The).

**2.02 ESCUTCHEONS**

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

**2.03 FLOOR PLATES**

- A. Split Floor Plates: Cast brass with concealed hinge.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece cast brass or split-casting brass with polished, chrome-plated finish.

- c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
- d. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
- f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
- h. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

- 1. New Piping: Split floor plate.

### **3.02 FIELD QUALITY CONTROL**

A. Using new materials, replace broken and damaged escutcheons and floor plates.

**END OF SECTION 220518**

**SECTION 220519****METERS AND GAGES FOR PLUMBING PIPING****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  1. Bimetallic-actuated thermometers.
  2. Liquid-in-glass thermometers.
  3. Thermowells.
  4. Dial-type pressure gages.
  5. Gage attachments.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of meter and gage.

**1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

**PART 2 - PRODUCTS****2.01 BIMETALLIC-ACTUATED THERMOMETERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ashcroft Inc.
  2. Palmer Wahl Instrumentation Group.
  3. Weiss Instruments, Inc.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, adjustable angle rigid, back and rigid, bottom, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.



- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

## 2.02 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
  - 1. Standard: ASME B40.200.
  - 2. Case: Cast aluminum; 6-inch nominal size.
  - 3. Case Form: Back angle unless otherwise indicated.
  - 4. Tube: Glass with magnifying lens and blue organic liquid.
  - 5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  - 6. Window: Glass or plastic.
  - 7. Stem: Aluminum or brass and of length to suit installation.
    - a. Design for Thermowell Installation: Bare stem.
  - 8. Connector: 3/4 inch, with ASME B1.1 screw threads.
  - 9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 2.03 THERMOWELLS

- A. Thermowells:
  - 1. Standard: ASME B40.200.
  - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
  - 3. Material for Use with Copper Tubing: CNR or CUNI.
  - 4. Material for Use with Steel Piping: CRES.
  - 5. Type: Stepped shank unless straight or tapered shank is indicated.
  - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
  - 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
  - 8. Bore: Diameter required to match thermometer bulb or stem.
  - 9. Insertion Length: Length required to match thermometer bulb or stem.
  - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
  - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.04 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ashcroft Inc.
    - b. Palmer Wahl Instrumentation Group.
    - c. Weiss Instruments, Inc.
  - 2. Standard: ASME B40.100.

3. Case: Liquid-filled Sealed Solid-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## **2.05 GAGE ATTACHMENTS**

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install thermometers in the following locations:
  1. Inlet and outlet of each water heater.
- K. Install pressure gages in the following locations:
  1. Building water service entrance into building.
  2. Suction and discharge of each domestic water pump.
- L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- M. Adjust faces of meters and gages to proper angle for best visibility.

**3.02 THERMOMETER SCHEDULE**

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
  - 1. Liquid-filled Sealed, bimetallic-actuated type.
  - 2. Metal case, compact-style, liquid-in-glass type.
- B. Thermometer stems shall be of length to match thermowell insertion length.

**3.03 THERMOMETER SCALE-RANGE SCHEDULE**

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.
- C. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F.

**3.04 PRESSURE-GAGE SCHEDULE**

- A. Pressure gages at discharge of each water service into building shall be the following:
  - 1. Liquid-filled Sealed Solid-front, pressure-relief, direct-mounted, metal case.
- B. Pressure gages at suction and discharge of each domestic water pump shall be the following:
  - 1. Liquid-filled Sealed Solid-front, pressure-relief, direct-mounted, metal case.

**3.05 PRESSURE-GAGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Water Service Piping: 0 to 160 psi.
- B. Scale Range for Domestic Water Piping: 0 to 100 psi.
- C. Scale Range for Domestic Water Piping: 0 to 160 psi.

**END OF SECTION 220519**

**SECTION 220523.12****BALL VALVES FOR PLUMBING PIPING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Brass ball valves.
  - 2. Bronze ball valves.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 and NSF 372.

**PART 2 - PRODUCTS****2.01 GENERAL REQUIREMENTS FOR VALVES**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 3. ASME B16.18 for solder-joint connections.
  - 4. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
  - 2. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
  - 1. Include 2-inch stem extensions.
  - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
  - 3. Memory stops that are fully adjustable after insulation is applied.

**2.02 BRASS BALL VALVES**

- A. Brass Ball Valves, One-Piece:
  - 1. Description:

- a. Standard: MSS SP-110.
  - b. CWP Rating: 400 psig.
  - c. Body Design: One piece.
  - d. Body Material: Forged brass or bronze.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Brass or stainless steel.
  - h. Ball: Chrome-plated brass or stainless steel.
  - i. Port: Reduced.
  - j. Adjustable packing gland.
- B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:
- 1. Description:
    - a. Standard: MSS SP-110 or MSS SP-145.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Forged brass.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Brass.
    - h. Ball: Chrome-plated brass.
    - i. Port: Full.
    - j. Adjustable packing gland.
- C. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Press Ends:
- 1. Description:
    - a. Standard: MSS SP-110 or MSS SP-145.
    - b. CWP Rating: Minimum 200 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Forged brass.
    - e. Ends: Press.
    - f. Press Ends Connection Rating: Minimum 200 psig.
    - g. Seats: PTFE or RPTFE.
    - h. Stem: Brass.
    - i. Ball: Chrome-plated brass.
    - j. Port: Full.
    - k. O-Ring: Buna-N or EPDM.
    - l. Adjustable packing gland.
- D. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:
- 1. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Forged brass.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Brass.
    - h. Ball: Chrome-plated brass.
    - i. Port: Regular.
    - j. Adjustable packing gland.

## 2.03 BRONZE BALL VALVES

- A. Bronze Ball Valves, One-Piece:
- 1. Description:

- a. Standard: MSS SP-110.
  - b. CWP Rating: 400 psig.
  - c. Body Design: One piece.
  - d. Body Material: Bronze.
  - e. Ends: Threaded.
  - f. Seats: PTFE.
  - g. Stem: Bronze.
  - h. Ball: Chrome-plated brass.
  - i. Port: Reduced.
  - j. Adjustable packing gland.
- B. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:
- 1. Description:
    - a. Standard: MSS SP-110 or MSS-145.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Bronze.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Bronze or brass.
    - h. Ball: Chrome-plated brass.
    - i. Port: Full.
    - j. Adjustable packing gland.
- C. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:
- 1. Description:
    - a. Standard: MSS SP-110 or MSS-145.
    - b. CWP Rating: Minimum 200 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Bronze.
    - e. Ends: Press.
    - f. Press Ends Connections Rating: Minimum 200 psig.
    - g. Seats: PTFE or RTPFE.
    - h. Stem: Bronze or brass.
    - i. Ball: Chrome-plated brass.
    - j. Port: Full.
    - k. O-Ring Seal: EPDM or Buna-N.
    - l. Adjustable packing gland.
- D. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:
- 1. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Bronze.
    - e. Ends: Threaded.
    - f. Seats: PTFE.
    - g. Stem: Bronze or brass.
    - h. Ball: Chrome-plated brass.
    - i. Port: Regular.
    - j. Adjustable packing gland.

**PART 3 - EXECUTION****3.01 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

**3.02 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

**3.03 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE**

- A. Pipe NPS 2 and Smaller:
  - 1. Brass ball valve, one piece. Provide with threaded or solder-joint ends.
  - 2. Bronze ball valve, one piece with bronze trim. Provide with threaded or solder-joint ends.
  - 3. Brass ball valves, two-piece with full port and brass trim. Provide with threaded solder or press connection-joint ends.
  - 4. Bronze ball valves, two-piece with full port and bronze or brass trim. Provide with threaded solder or press-connection-joint ends.

**END OF SECTION 220523.12**

**SECTION 220523.14****CHECK VALVES FOR PLUMBING PIPING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Bronze swing check valves.
  - 2. Bronze swing check valves, press ends.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 and NSF 372.

**PART 2 - PRODUCTS****2.01 GENERAL REQUIREMENTS FOR VALVES**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 4. ASME B16.18 for solder joint.
  - 5. ASME B31.9 for building services piping valves.
- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.

**2.02 BRONZE SWING CHECK VALVES**

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:
  - 1. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B62, bronze.
    - e. Ends: Threaded or soldered. See valve schedule articles.
    - f. Disc: Bronze.



- B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:
  - 1. Description:
    - a. Standard: MSS SP-80, Type 4.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B62, bronze.
    - e. Ends: Threaded or soldered. See valve schedule articles.
    - f. Disc: PTFE.
- C. Bronze Swing Check Valves, Press Ends:
  - 1. Description:
    - a. Standard: MSS SP-80 and MSS SP-139.
    - b. CWP Rating: Minimum 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B584, bronze.
    - e. Ends: Press.
    - f. Press Ends Connection Rating: Minimum 200 psig
    - g. Disc: Brass or bronze.

### **PART 3 - EXECUTION**

#### **3.01 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

#### **3.02 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

#### **3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valve applications are not indicated, use the following:
  - 1. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; metal-seat or resilient-seat check valves.
    - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered or press-ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 5 and Larger: Flanged.
4. For Steel Piping, NPS 2 and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
6. For Steel Piping, NPS 5 and Larger: Flanged.

**3.04 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE**

- A. Pipe NPS 2 1/2" and Smaller:
1. Bronze swing check valves bronze disc, Class 125, with soldered or threaded end connections.
  2. Bronze swing check valves with press-end connections.

**END OF SECTION 220523.14**

**SECTION 220529****HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Thermal hanger-shield inserts.
  - 4. Fastener systems.
  - 5. Pipe-positioning systems.
  - 6. Equipment supports.
  
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
  - 3. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

**1.04 QUALITY ASSURANCE**

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## 2.02 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe and Tube Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

## 2.03 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.04 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. B-line, an Eaton business.
    - b. Hilti, Inc.
    - c. MKT Fastening, LLC.
  - 2. Indoor Applications: Zinc-coated steel.
  - 3. Outdoor Applications: Stainless steel.

## 2.05 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.06 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

## 2.07 MATERIALS

- A. Aluminum: ASTM B221.

- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

### **PART 3 - EXECUTION**

#### **3.01 APPLICATION**

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

#### **3.02 HANGER AND SUPPORT INSTALLATION**

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fastener System Installation:
  - 1. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.

- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  - 6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### **3.03 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.04 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

### **3.05 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### **3.06 PAINTING**

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### **3.07 HANGER AND SUPPORT SCHEDULE**

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use thermal hanger-shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
- M. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

**END OF SECTION 220529**



**SECTION 220548.13****VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Elastomeric isolation pads.
  - 2. Elastomeric isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Open-spring isolators.
  - 5. Housed-spring isolators.
  - 6. Restrained-spring isolators.
  - 7. Housed-restrained-spring isolators.
  - 8. Pipe-riser resilient supports.
  - 9. Resilient pipe guides.
  - 10. Elastomeric hangers.
  - 11. Spring hangers.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each vibration isolation device.
  - 1. Include design calculations for selecting vibration isolators.

**PART 2 - PRODUCTS****2.01 ELASTOMERIC ISOLATION PADS**

- A. Elastomeric Isolation Pads:
  - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 2. Size: Factory or field cut to match requirements of supported equipment.
  - 3. Pad Material: Oil and water resistant with elastomeric properties.
  - 4. Surface Pattern: Smooth pattern.
  - 5. Infused nonwoven cotton or synthetic fibers.
  - 6. Load-bearing metal plates adhered to pads.

**2.02 ELASTOMERIC ISOLATION MOUNTS**

- A. Double-Deflection, Elastomeric Isolation Mounts: .
  - 1. Mounting Plates:
    - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
    - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
  - 2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

**2.03 RESTRAINED ELASTOMERIC ISOLATION MOUNTS**

- A. Restrained Elastomeric Isolation Mounts: .
1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
    - a. Housing: Cast-ductile iron or welded steel.
    - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

**2.04 OPEN-SPRING ISOLATORS**

- A. Freestanding, Laterally Stable, Open-Spring Isolators: .
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
  6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

**2.05 HOUSED-SPRING ISOLATORS**

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top housing with attachment and leveling bolt elastomeric pad.

**2.06 RESTRAINED-SPRING ISOLATORS**

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: .
1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top plate with threaded mounting holes elastomeric pad.
    - c. Internal leveling bolt that acts as blocking during installation.
  2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

**2.07 HOUSED-RESTRAINED-SPRING ISOLATORS**

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .
- Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    - Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
  - Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

**2.08 PIPE-RISER RESILIENT SUPPORT**

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
- Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  - Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

**2.09 RESILIENT PIPE GUIDES**

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
- Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

**2.10 ELASTOMERIC HANGERS**

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
- Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
  - Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

**2.11 SPRING HANGERS**

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .
- Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  - Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

### **PART 3 - EXECUTION**

#### **3.01 VIBRATION CONTROL DEVICE INSTALLATION**

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

**END OF SECTION 220548.13**

**SECTION 220553****IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

**PART 2 - PRODUCTS****2.01 EQUIPMENT LABELS**

- A. Plastic Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Craftmark Pipe Markers.
    - c. Seton Identification Products; a Brady Corporation company.
  2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  3. Letter Color: Black.
  4. Background Color: White.
  5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  8. Fasteners: Stainless-steel rivets or self-tapping screws.
  9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

**2.02 WARNING SIGNS AND LABELS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Craftmark Pipe Markers.
  - 3. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: White.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

**2.03 PIPE LABELS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Craftmark Pipe Markers.
  - 3. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

**PART 3 - EXECUTION****3.01 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

**3.02 PIPE LABEL INSTALLATION**

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
  - 1. Low-Pressure Compressed Air Piping:
    - a. Background: Safety blue.
    - b. Letter Colors: White.
  - 2. High-Pressure Compressed Air Piping:
    - a. Background: Safety blue.
    - b. Letter Colors: White.
  - 3. Domestic Water Piping
    - a. Background: Safety green.
    - b. Letter Colors: White.
  - 4. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Safety black.
    - b. Letter Color: White.

**END OF SECTION 220553**

**SECTION 220716****PLUMBING EQUIPMENT INSULATION****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section includes insulating the following plumbing equipment that is not factory insulated:
  - 1. Domestic water, hot-water cold-water pumps.
- B. Related Sections:
  - 1. Section 220719 "Plumbing Piping Insulation."

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail removable insulation at equipment connections.
  - 2. Detail application of field-applied jackets.
  - 3. Detail application at linkages of control devices.
  - 4. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Material test reports
- C. Field quality-control reports.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

**1.05 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."



- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

#### 1.06 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### PART 2 - PRODUCTS

#### 2.01 INSULATION MATERIALS

- A. Comply with requirements in "Indoor Equipment Insulation Schedule" Article for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type II for sheet materials.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
- G. Mineral-Fiber, Pipe and Tank: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C1393.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Owens Corning.
  - 2. Semirigid board material with factory-applied ASJ jacket.
  - 3. Nominal density is 2.5 lb/cu. ft. or more.
  - 4. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
  - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

**2.02 ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
  2. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  3. Wet Flash Point: Below 0 deg F
  4. Service Temperature Range: 40 to 200 deg F.
  5. Color: Black.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
- D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Consumer Solutions.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. P.I.C. Plastics, Inc.
    - d. Speedline Corporation.

**2.03 MASTICS AND COATINGS**

- A. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Knauf Insulation.
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: 0 to plus 180 deg F.
  4. Color: White.

**2.04 SEALANTS**

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

- B. Joint Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
    - d. Pittsburgh Corning Corporation.
  2. Permanently flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 150 to plus 250 deg F.
  4. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
- D. ASJ Flashing Sealants and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: White.

## 2.05 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

## 2.06 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 4 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering equipment.

## 2.07 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
    - d. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ITW Insulation Systems; Illinois Tool Works, Inc.
    - b. RPR Products, Inc.
  2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. ITW Insulation Systems; Illinois Tool Works, Inc.

## 2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M.
    - b. Avery Dennison Corporation, Specialty Tapes Division.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ideal Tape Co., Inc., an American Biltrite Company.
    2. Width: 2 inches.
    3. Thickness: 6 mils.
    4. Adhesion: 64 ounces force/inch in width.
    5. Elongation: 500 percent.
    6. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M.
    - b. Avery Dennison Corporation, Specialty Tapes Division.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.
- D. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. ITW Insulation Systems; Illinois Tool Works, Inc.
  2. Width: 3 inches.
  3. Film Thickness: 2 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 20 psi.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 PREPARATION**

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

### **3.03 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of equipment, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- O. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### **3.04 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION**

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
  - 1. Apply adhesives in accordance with manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  - 3. Protect exposed corners with secured corner angles.
  - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints and 16 inches o.c. in both directions.
    - d. Do not over-compress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins, and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 5. Secure each layer of insulation with stainless steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.

### **3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.06 FIELD-APPLIED JACKET INSTALLATION**

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.
- D. Where PVDC jackets are indicated, install as follows:
1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
  2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.



**3.07 FINISHES**

- A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

**3.08 FIELD QUALITY CONTROL**

- A. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Owner or Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Indoor Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- B. All insulation applications will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

**3.09 INDOOR EQUIPMENT INSULATION SCHEDULE**

- A. Insulate indoor and outdoor equipment that is not factory insulated.

**3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

**3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

**END OF SECTION 220716**

**SECTION 220719****PLUMBING PIPING INSULATION****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.
  - 4. Roof drains and rainwater leaders.
  - 5. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
  - 1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at pipe expansion joints for each type of insulation.
  - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 5. Detail application of field-applied jackets.
  - 6. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Material test reports.
- C. Field quality-control reports.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

### 1.05 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

### 1.06 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Pittsburgh Corning Corporation.
  2. Preformed Pipe Insulation: Type II, Class 1, without jacket.
  3. Preformed Pipe Insulation: Type II, Class 2, with factory-applied **ASJ** jacket.

4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
- H. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
    - d. Owens Corning.
  2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
  3. 850 deg F.
  4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  2. Wet Flash Point: Below 0 deg F.
  3. Service Temperature Range: 40 to 200 deg F.
  4. Color: Black.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.

## 2.03 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.

- b. Foster Brand; H. B. Fuller Construction Products.
- c. Knauf Insulation.
2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

#### **2.04 SEALANTS**

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
  1. Permanently flexible, elastomeric sealant.
  2. Service Temperature Range: Minus 58 to plus 176 deg F.
  3. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
  1. Fire- and water-resistant, flexible, elastomeric sealant.
  2. Service Temperature Range: Minus 40 to plus 250 deg F.
  3. Color: Aluminum.
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
  1. Fire- and water-resistant, flexible, elastomeric sealant.
  2. Service Temperature Range: Minus 40 to plus 250 deg F.
  3. Color: White.

#### **2.05 FACTORY-APPLIED JACKETS**

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

#### **2.06 FIELD-APPLIED FABRIC-REINFORCING MESH**

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

#### **2.07 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Adhesive: As recommended by jacket material manufacturer.
  2. Color: White.
  3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
- 1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

## 2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
- 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
- 1. Width: 3 inches.
  - 2. Thickness: 6.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
- 1. Width: 2 inches.
  - 2. Thickness: 6 mils.
  - 3. Adhesion: 64 ounces force/inch in width.
  - 4. Elongation: 500 percent.

5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

## **2.09 SECUREMENTS**

- A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
  2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.

## **2.10 PROTECTIVE SHIELDING GUARDS**

- A. Protective Shielding Pipe Covers,:
1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures,:
1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

**3.02 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.



- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Cleanouts.

### 3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.04 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe

- insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.05 INSTALLATION OF CELLULAR-GLASS INSULATION**

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.

### **3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.07 INSTALLATION OF MINERAL-FIBER INSULATION**

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as that of straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### **3.08 INSTALLATION OF POLYOLEFIN INSULATION**

- A. Insulation Installation on Straight Pipes and Tubes:
1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.09 FIELD-APPLIED JACKET INSTALLATION**

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### **3.10 FINISHES**

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

### **3.11 FIELD QUALITY CONTROL**

- A. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Owner or Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.12 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### **3.13 INDOOR PIPING INSULATION SCHEDULE**

- A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
  2. NPS 1-1/4 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
1. NPS 1-1/4 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  2. NPS 1-1/2 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Stormwater and Overflow:
1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

### **3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE**

- A. Domestic Water Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

### **3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
1. PVC: 20 mils thick.
- D. Piping, Exposed:
1. PVC: 20 mils thick.

### **3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
  - 1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

**3.17 UNDERGROUND, FIELD-APPLIED INSULATION JACKET**

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

**END OF SECTION 220719**



**SECTION 221116**  
**DOMESTIC WATER PIPING**

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. Ductile-iron pipe and fittings.
  - 3. Galvanized steel pipe and fittings.
  - 4. Piping joining materials.
  - 5. Transition fittings.
  - 6. Dielectric fittings.
  
- B. Related Requirements:
  - 1. Section 221113 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For transition fittings and dielectric fittings.

**1.03 INFORMATIONAL SUBMITTALS**

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

**PART 2 - PRODUCTS****2.01 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

**2.02 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:

1. MSS SP-123.
  2. Cast-copper-alloy, hexagonal-stock body.
  3. Ball-and-socket, metal-to-metal seating surfaces.
  4. Solder-joint or threaded ends.
- G. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:
1. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
  2. Minimum 200-psig working-pressure rating at 250 deg F.

### **2.03 GALVANIZED-STEEL PIPE AND FITTINGS**

- A. Galvanized-Steel Pipe:
1. ASTM A 53/A 53M, Type E, Grade B, Standard Weight.
  2. Include ends matching joining method.
- B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
- C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Malleable-Iron Unions:
1. ASME B16.39, Class 150.
  2. Hexagonal-stock body.
  3. Ball-and-socket, metal-to-metal, bronze seating surface.
  4. Threaded ends.
- E. Flanges: ASME B16.1, Class 125, cast iron.

### **2.04 PIPING JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials:
1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

### **2.05 TRANSITION FITTINGS**

- A. General Requirements:
1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.

- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

## **2.06 DIELECTRIC FITTINGS**

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Standard: ASSE 1079.
  - 2. Pressure Rating: 125 psig minimum at 180 deg F.
  - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Standard: ASSE 1079.
  - 2. Factory-fabricated, bolted, companion-flange assembly.
  - 3. Pressure Rating: 125 psig minimum at 180 deg F.
  - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
  - 1. Nonconducting materials for field assembly of companion flanges.
  - 2. Pressure Rating: 150 psig.
  - 3. Gasket: Neoprene or phenolic.
  - 4. Bolt Sleeves: Phenolic or polyethylene.
  - 5. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
  - 1. Standard: IAPMO PS 66.
  - 2. Electroplated steel nipple complying with ASTM F 1545.
  - 3. Pressure Rating and Temperature: 300 psig at 225 deg F.
  - 4. End Connections: Male threaded or grooved.
  - 5. Lining: Inert and noncorrosive, propylene.

## **PART 3 - EXECUTION**

### **3.01 EARTHWORK**

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### **3.02 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- F. Install domestic water piping level and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- H. Install restraints on piping. Comply with requirements for restraint devices in Section 220548 "Vibration Controls for Plumbing Piping and Equipment."
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping to permit valve servicing.
- M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.
- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- R. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Inline Domestic Water Pumps."
- S. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

**3.03 JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

**3.04 TRANSITION FITTING INSTALLATION**

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

**3.05 DIELECTRIC FITTING INSTALLATION**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

**3.06 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install hangers for copper and galvanized steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of copper galvanized steel and to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### **3.07 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### **3.08 IDENTIFICATION**

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### **3.09 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

- 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
- 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
  - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
  1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to fully open position.
  3. Open throttling valves to proper setting.
  4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Repeat procedures if biological examination shows contamination.
  - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### **3.12 PIPING SCHEDULE**

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
  1. Soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
  1. soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and solder joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.

**END OF SECTION 221116**



**SECTION 221119****DOMESTIC WATER PIPING SPECIALTIES****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Balancing valves.
  - 4. Temperature-actuated, water mixing valves.
  - 5. Strainers.
  - 6. Hose bibbs.
  - 7. Wall hydrants.
  - 8. Drain valves.
  - 9. Water-hammer arresters.
  - 10. Trap-seal primer valves.
- B. Related Requirements:
  - 1. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
  - 2. Section 221116 "Domestic Water Piping" for water meters.
  - 3. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
  - 4. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  - 1. Include diagrams for power, signal, and control wiring.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.05 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

**PART 2 - PRODUCTS****2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES**

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

- B. Comply with NSF 372 for low lead.

## 2.02 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

## 2.03 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Standard: ASSE 1001.
  - 2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
  - 3. Body: Bronze.
  - 4. Inlet and Outlet Connections: Threaded.
  - 5. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
  - 1. Standard: ASSE 1011.
  - 2. Body: Bronze, nonremovable, with manual drain.
  - 3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  - 4. Finish: Chrome or nickel plated.

## 2.04 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ames Fire & Waterworks; A WATTS Brand.
    - b. Apollo Flow Controls; Conbraco Industries, Inc.
    - c. FEBCO; A WATTS Brand.
    - d. WATTS.
    - e. Zurn Industries, LLC.
  - 2. Standard: ASSE 1013.
  - 3. Operation: Continuous-pressure applications.
  - 4. Pressure Loss: 12 psig maximum, through middle third of flow range.
  - 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
  - 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  - 7. Configuration: Designed for horizontal, straight-through flow.
  - 8. Accessories:
    - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

## 2.05 BALANCING VALVES

- A. Memory-Stop Balancing Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. Milwaukee Valve Company.
    - c. NIBCO INC.
    - d. Red-White Valve Corp.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

## 2.06 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Lawler Manufacturing Company, Inc.
    - b. Leonard Valve Company.
    - c. Symmons Industries, Inc.
  2. Standard: ASSE 1017.
  3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
  5. Material: Bronze body with corrosion-resistant interior components.
  6. Connections: Threaded union inlets and outlet.
  7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
  8. Valve Finish: Rough bronze.
  9. Piping Finish: Copper.
  10. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

## 2.07 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
  2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
  3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  4. Screen: Stainless steel with round perforations unless otherwise indicated.
  5. Perforation Size:
    - a. Strainers NPS 2 and Smaller: 0.020 inch.
    - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    - c. Strainers NPS 5 and Larger: 0.10 inch.
  6. Drain: Factory-installed, hose-end drain valve.

## 2.08 HOSE BIBBS

- A. Hose Bibbs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Woodford Manufacturing Company.
    - c. Zurn Industries, LLC.
  2. Standard: ASME A112.18.1 for sediment faucets.
  3. Body Material: Bronze.
  4. Seat: Bronze, replaceable.

5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough bronze.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.09 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. WATTS.
  - c. Woodford Manufacturing Company.
  - d. Zurn Industries, LLC.
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

## 2.10 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.11 TRAP-SEAL PRIMER DEVICE

### A. Drainage-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.

2. Size: NPS 1-1/4 minimum.
3. Material: Chrome-plated, cast brass.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- B. Balancing Valves: Install in locations where they can easily be adjusted.
- C. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Y-Pattern Strainers: For water, install on supply side of each solenoid valve and pump.
- E. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- F. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

#### **3.02 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.
- C. Comply with requirements for grounding equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

#### **3.03 IDENTIFICATION**

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  1. Reduced-pressure-principle backflow preventers.
  2. Carbonated-beverage-machine backflow preventers.
  3. Calibrated balancing valves.
  4. Primary, thermostatic, water mixing valves.
  5. Manifold, thermostatic, water mixing-valve assemblies.
  6. Outlet boxes.
  7. Hose stations.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

#### **3.04 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

#### **3.05 ADJUSTING**

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

**END OF SECTION 221119**

**SECTION 221123.21****INLINE, DOMESTIC-WATER PUMPS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. In-line, sealless centrifugal pumps.
  - 2. Horizontally mounted, in-line, close-coupled centrifugal pumps.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Detail pumps and adjacent equipment, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Seismic Qualification Data: Certificates, for inline, domestic-water pumps, accessories, and components, from manufacturer.
- C. Field quality-control reports.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: UL 778 for motor-operated water pumps.
- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

**2.02 IN-LINE, SEALLESS CENTRIFUGAL PUMPS**

- A. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- B. Pump Construction:
  - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
  - 2. Minimum Working Pressure: 125 psig.
  - 3. Maximum Continuous Operating Temperature: 220 deg F.
  - 4. Casing: Bronze, with threaded or companion-flange connections.

5. Impeller: stainless steel.
6. Motor: Single speed.

### **2.03 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS**

- A. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.
- B. Pump Construction:
  1. Casing:
    - a. Radially split bronze with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
    - b. Built to permit servicing of pump internals without disturbing the casing or the suction and discharge piping.
    - c. Gauge port tapings at suction and discharge nozzles.
  2. Impeller: Bronze or brass, statically and dynamically balanced, closed, and keyed to shaft.
  3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
  4. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
  5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
  6. Bearings: permanently lubricated ball type.
  7. Minimum Working Pressure: 175 psig.
  8. Continuous Operating Temperature: 225 deg F.
- C. Motor: Single speed, with grease-lubricated ball bearings; resiliently or rigidly mounted to pump casing.

### **2.04 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
  1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

### **2.05 CONTROLS**

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
  1. Type: Water-immersion temperature sensor, for installation in piping.
  2. Range: 65 to 200 deg F.
  3. Enclosure: NEMA 250, Type 4X.
  4. Operation of Pump: On or off.
  5. Transformer: Provide if required.
- B. Timers: Electric, for control of hot-water circulation pump.
  1. Type: Programmable, seven-day clock with manual override on-off switch.
  2. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
  3. Operation of Pump: On or off.
  4. Transformer: Provide if required.
  5. Power Requirement: 120 V ac.
  6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.



**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
  - 1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
  - 2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- D. Install thermostats in hot-water return piping.
- E. Install timers on wall in mechanical room.
- F. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.
- G. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Set thermostats and timers for automatic starting and stopping operation of pumps.
  - 5. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c. Verify that pump is rotating in the correct direction.
  - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 7. Start motor.
  - 8. Open discharge valve slowly.
  - 9. Adjust temperature settings on thermostats.
  - 10. Adjust timer settings.

**3.02 PIPING CONNECTIONS**

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
  - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
    - a. Horizontally mounted, in-line, close-coupled centrifugal pumps.

- b. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:
  - 1. Section 220523.12 "Ball Valves for Plumbing Piping."
  - 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
  - 3. Section 220523.14 "Check Valves for Plumbing Piping."
  - 4. Section 220523.15 "Gate Valves for Plumbing Piping."
  - 5. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tapings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

### **3.03 CONTROL CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between temperature controllers and devices.
- C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

### **3.04 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### **3.05 ADJUSTING**

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

**END OF SECTION 221123.21**

**SECTION 221313****FACILITY SANITARY SEWERS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. Hubless cast-iron soil pipe and fittings.
  - 3. Nonpressure-type transition couplings.
  - 4. Pressure-type pipe couplings.
  - 5. Cleanouts.
  - 6. Concrete.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings:
  - 1. Show system piping in profile. Draw profiles to horizontal scale of not less than 1 inch equals 50 feet and to vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- B. Product Certificates: For each type of pipe and fitting.
- C. Field quality-control reports.

**PART 2 - PRODUCTS****2.01 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A74, Service class.
- B. Gaskets: ASTM C564, rubber.
- C. Calking Materials: ASTM B29, pure lead and oakum or hemp fiber.

**2.02 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A888 or CISPI 301.
- B. CISPI-Trademark, Shielded Couplings:
  - 1. Description: ASTM C1277 and CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ANACO-Husky.
  - b. Charlotte Pipe and Foundry Company.
  - c. Mission Rubber Company, LLC; a division of MCP Industries.
  - d. Tyler Pipe; a subsidiary of McWane Inc.

### **2.03 PVC PIPE AND FITTINGS**

- A. PVC Corrugated Sewer Piping:
  1. Pipe: ASTM F949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
  2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
  3. Gaskets: ASTM F477, elastomeric seals.
- B. PVC Type PSM Sewer Piping:
  1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
  2. Fittings: ASTM D3034, PVC with bell ends.
  3. Gaskets: ASTM F477, elastomeric seals.

### **2.04 NONPRESSURE-TYPE TRANSITION COUPLINGS**

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  1. For Cast-Iron Soil Pipes: ASTM C564, rubber.
  2. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
  3. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- C. Nonpressure-Type, Rigid Couplings:
  1. Description: ASTM C1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

### **2.05 CLEANOUTS**

- A. Cast-Iron Cleanouts:
  1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
  2. Top-Loading Classification(s): Heavy Duty.
  3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.

### **2.06 CONCRETE**

- A. General: Cast-in-place concrete complying with ACI 318, ACI 350, and the following:
  1. Cement: ASTM C150/C150M, Type II.
  2. Fine Aggregate: ASTM C33/C33M, sand.
  3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
  4. Water: Potable.

- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
  - 1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
  - 2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.
- C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
  - 1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
  - 2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

### **PART 3 - EXECUTION**

#### **3.01 EARTHWORK**

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

#### **3.02 PIPING INSTALLATION**

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- E. Install gravity-flow, nonpressure, drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
  - 2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
  - 3. Install piping with 36-inch minimum cover.
  - 4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  - 5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  - 6. Install PVC corrugated sewer piping according to ASTM D2321 and ASTM F1668.
  - 7. Install PVC Type PSM sewer piping according to ASTM D2321 and ASTM F1668.
- F. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A674 or AWWA C105/A21.5:
  - 1. Hub-and-spigot, cast-iron soil pipe.
  - 2. Hubless cast-iron soil pipe and fittings.
  - 3. Expansion joints and deflection fittings.

- G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

### **3.03 PIPE JOINT CONSTRUCTION**

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
  1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
  3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
  4. Join PVC corrugated sewer piping according to ASTM D2321.
  5. Join PVC Type PSM sewer piping according to ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasket joints.
  6. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
  1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    - a. Unshielded flexible or rigid couplings for pipes of same or slightly different OD.
    - b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

### **3.04 CONCRETE PLACEMENT**

- A. Place cast-in-place concrete according to ACI 318.

### **3.05 CLEANOUT INSTALLATION**

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
  1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
  2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
  3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
  4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

### **3.06 CONNECTIONS**

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
  - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
  - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

- C. Connect to grease interceptors specified in Section 221323 "Sanitary Waste Interceptors."

### **3.07 IDENTIFICATION**

- A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
1. Use warning tape or detectable warning tape over ferrous piping.
  2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

### **3.08 FIELD QUALITY CONTROL**

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate report for each system inspection.
  2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to requirements of authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.



4. Submit separate report for each test.
  5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
    - a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
    - b. Close openings in system and fill with water.
    - c. Purge air and refill with water.
    - d. Disconnect water supply.
    - e. Test and inspect joints for leaks.
  6. Manholes: Perform hydraulic test according to ASTM C969.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

**END OF SECTION 221313**

**SECTION 221316****SANITARY WASTE AND VENT PIPING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. PVC pipe and fittings.
  - 3. Specialty pipe fittings.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
- B. Field quality-control reports.

**1.04 WARRANTY**

- A. Listed manufacturers to provide labeling and warranty of their respective products.

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

**2.02 PIPING MATERIALS**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

**2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Charlotte Pipe and Foundry Company.
  - 2. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings: ASTM A 74, Service class.

- C. Gaskets: ASTM C 564, rubber.
- D. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

#### **2.04 PVC PIPE AND FITTINGS**

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
- E. Solvent Cement: ASTM D 2564.

#### **2.05 SPECIALTY PIPE FITTINGS**

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Shielded, Nonpressure Transition Couplings:
    - a. Standard: ASTM C 1460.
    - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. End Connections: Same size as and compatible with pipes to be joined.

### **PART 3 - EXECUTION**

#### **3.01 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

#### **3.02 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- O. Install underground PVC piping according to ASTM D 2321.
- P. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

- R. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### **3.03 JOINT CONSTRUCTION**

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

### **3.04 SPECIALTY PIPE FITTING INSTALLATION**

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
  - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

### **3.05 VALVE INSTALLATION**

- A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.
- B. Shutoff Valves:
  - 1. Install shutoff valve on each sewage pump discharge.
  - 2. Install gate or full-port ball valve for piping NPS 2 and smaller.
  - 3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

**3.06 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

**3.07 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  5. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

**3.08 IDENTIFICATION**

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

**3.09 FIELD QUALITY CONTROL**

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

**3.10 CLEANING AND PROTECTION**

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
    - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
  - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
  - 3. Cast Iron Pipe and Fittings: ASTM A 74, Service class, Gaskets: ASTM C 564, rubber. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.
- G. Underground, soil and waste piping NPS 5 and larger shall be the following:
  - 1. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
  - 3. Cast Iron Pipe and Fittings: ASTM A 74, Service class, Gaskets: ASTM C 564, rubber. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

**END OF SECTION 221316**



**SECTION 221319****SANITARY WASTE PIPING SPECIALTIES****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Backwater valves.
  - 2. Cleanouts.
  - 3. Miscellaneous sanitary drainage piping specialties.
  
- B. Related Requirements:
  - 1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
  - 2. Section 077200 "Roof Accessories" for preformed flashings.
  - 3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
  - 4. Section 221323 "Sanitary Waste Interceptors" for metal and concrete interceptors outside the building, grease interceptors, grease-removal devices, oil interceptors, and solids interceptors.
  - 5. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
  - 6. Section 334200 "Stormwater Conveyance" for storm drainage piping and piping specialties outside the building.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  
- B. Shop Drawings:
  - 1. Show fabrication and installation details for frost-resistant vent terminals.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS****2.01 ASSEMBLY DESCRIPTIONS**

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
  
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

**2.02 CLEANOUTS**

- A. Cast-Iron Exposed Cleanouts:
  - 1. Standard: ASME A112.36.2M.

2. Size: Same as connected drainage piping
  3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  4. Closure: Countersunk, plastic plug.
  5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts:
1. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule threaded, adjustable housing cleanout.
  2. Size: Same as connected branch.
  3. Type: Adjustable housing Cast-iron soil pipe with cast-iron ferrule Threaded, adjustable housing.
  4. Body or Ferrule: Cast iron.
  5. Clamping Device: Required.
  6. Outlet Connection: Inside calk Spigot.
  7. Closure: Plastic plug.
  8. Adjustable Housing Material: Cast iron with threads.
  9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
  10. Frame and Cover Shape: Round.
  11. Top-Loading Classification: Heavy Duty.
  12. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
1. Standard: ASME A112.36.2M. Include wall access.
  2. Size: Same as connected drainage piping.
  3. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  4. Closure Plug:
    - a. Brass.
    - b. Countersunk or raised head.
    - c. Drilled and threaded for cover attachment screw.
    - d. Size: Same as or not more than one size smaller than cleanout size.
  5. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
  6. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

## **2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES**

- A. Open Drains:
1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
  2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
  2. Size: Same as connected waste piping.
    - a. NPS 2: 4-inch-minimum water seal.
    - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
  2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

- D. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
  2. Body: Bronze or cast iron.
  3. Inlet: Opening in top of body.
  4. Outlet: Larger than inlet.
  5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
  2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
  2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
  2. Size: Same as connected stack vent or vent stack.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Install backwater valves in building drain piping.
1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Assemble open drain fittings and install with top of hub 2 inches above floor.
- F. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  2. Size: Same as floor drain inlet.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install wood-blocking reinforcement for wall-mounting-type specialties.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### **3.02 PIPING CONNECTIONS**

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

### **3.03 LABELING AND IDENTIFYING**

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.04 PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION 221319**

**SECTION 221319.13**

**SANITARY DRAINS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Floor drains.

**1.02 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**PART 2 - PRODUCTS**

**2.01 DRAIN ASSEMBLIES**

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

**2.02 FLOOR DRAINS**

- A. Cast-Iron Floor Drains:
  - 1. Standard: ASME A112.6.3.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
  - 3. Set with grates depressed according to the following drainage area radii:

- a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
  - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
  - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
    - a. Maintain integrity of waterproof membranes where penetrated.
  5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- B. Install open drain fittings with top of hub 2 inches above floor.

### **3.02 CONNECTIONS**

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.
- D. Install piping adjacent to equipment to allow service and maintenance.
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.03 LABELING AND IDENTIFYING**

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.04 PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

### **END OF SECTION 221319.13**

**SECTION 224213.13****COMMERCIAL WATER CLOSETS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Water closets.
  - 2. Tanks.
  - 3. Toilet seats.
  - 4. Supports.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

**1.03 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For tank flushometer valves to include in operation and maintenance manuals.

**PART 2 - PRODUCTS****2.01 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS**

- A. Water Closets: Floor mounted, bottom outlet, top spud.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Zurn Industries, LLC.
  - 2. Bowl:
    - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    - b. Material: Vitreous china.
    - c. Type: Siphon jet.
    - d. Style: Tank
    - e. Height: Standard Handicapped/elderly, complying with ICC/ANSI A117.1.
    - f. Rim Contour: Elongated.
    - g. Water Consumption: 1.28 gal. per flush.
    - h. Color: White.
  - 3. Bowl-to-Drain Connecting Fitting: ASTM A1045 or ASME A112.4.3.

**2.02 TOILET SEATS**

- A. Toilet Seats:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Standard.
- b. Bemis Manufacturing Company.
- c. Church Seats; Bemis Manufacturing Company.
- d. Kohler Co.
- e. Olsonite Seat Co.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

## **2.03 SUPPORTS**

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Water-Closet Installation:
  1. Install level and plumb according to roughing-in drawings.
  2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
  3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
- B. Support Installation:
  1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
  2. Use carrier supports with waste-fitting assembly and seal.
  3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
- C. Install toilet seats on water closets.
- D. Wall Flange and Escutcheon Installation:
  1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
  2. Install deep-pattern escutcheons if required to conceal protruding fittings.
  3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Joint Sealing:
  1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
  2. Match sealant color to water-closet color.
  3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

#### **3.02 CONNECTIONS**

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."



- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

**3.03 ADJUSTING**

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

**3.04 CLEANING AND PROTECTION**

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

**END OF SECTION 224213.13**

**SECTION 224213.16****COMMERCIAL URINALS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Urinals.
  - 2. Flushometer valves.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

**1.03 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

**PART 2 - PRODUCTS****2.01 WALL-HUNG URINALS**

- A. Urinals: Wall hung, back outlet, washout, accessible.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Zurn Industries, LLC.
  - 2. Fixture:
    - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    - b. Material: Vitreous china.
    - c. Type: Washout with extended shields.
    - d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
    - e. Water Consumption: Low.
    - f. Spud Size and Location: NPS 3/4, top.
    - g. Outlet Size and Location: NPS 2, back.
    - h. Color: White.
  - 3. Waste Fitting:
    - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
    - b. Size: NPS 2.
  - 4. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights..
  - 5. Urinal Mounting Height: Standard Handicapped/elderly according to ICC A117.1.

**2.02 URINAL FLUSHOMETER VALVES**

- A. Lever-Handle, Diaphragm Flushometer Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Standard.
- b. Sloan Valve Company.
- c. Zurn Industries, LLC.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Consumption: 0.5 gal. per flush.
9. Minimum Inlet: NPS 3/4.
10. Minimum Outlet: NPS 1-1/4.

## 2.03 SUPPORTS

- A. Type I Urinal Carrier:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Josam Company.
    - c. Zurn Industries, LLC.
  2. Standard: ASME A112.6.1M.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Urinal Installation:
  1. Install urinals level and plumb according to roughing-in drawings.
  2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
  3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
  4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
  5. Install trap-seal liquid in waterless urinals.
- B. Support Installation:
  1. Install supports, affixed to building substrate, for wall-hung urinals.
  2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
  3. Use carriers without waste fitting for urinals with tubular waste piping.
  4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
- C. Flushometer-Valve Installation:
  1. Install flushometer-valve water-supply fitting on each supply to each urinal.
  2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
  3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- D. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
  2. Install deep-pattern escutcheons if required to conceal protruding fittings.
  3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Joint Sealing:
1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
  2. Match sealant color to urinal color.
  3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### **3.03 CONNECTIONS**

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

### **3.04 ADJUSTING**

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### **3.05 CLEANING AND PROTECTION**

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

**END OF SECTION 224213.16**

**SECTION 224216.13****COMMERCIAL LAVATORIES****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Lavatories.
  - 2. Faucets.
  - 3. Supports.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

**1.03 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Servicing and adjustments of automatic faucets.

**PART 2 - PRODUCTS****2.01 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES**

- A. Lavatory: Vitreous china, wall mounted, with back.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Zurn Industries, LLC.
  - 2. Fixture:
    - a. Standard: ASME A112.19.2/CSA B45.1.
    - b. Type: For wall hanging.
    - c. Nominal Size: Oval, 22 by 14 inches.
    - d. Faucet-Hole Punching: Three holes, 4-inch centers.
    - e. Faucet-Hole Location: Top.
    - f. Color: White.
    - g. Mounting Material: Chair carrier.
  - 3. Support: Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.
  - 4. Lavatory Mounting Height: Standard Handicapped/elderly according to ICC A117.1.

**2.02 SOLID-BRASS, MANUALLY OPERATED FAUCETS**

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

- B. Lavatory Faucets: Manual-type, single-control mixing two-handle mixing, commercial, solid-brass valve.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard.
    - b. Delta Faucet Company.
    - c. Moen Incorporated.
  2. Standard: ASME A112.18.1/CSA B125.1.
  3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
  4. Body Type: Centerset.
  5. Body Material: Commercial, solid brass.
  6. Finish: Polished chrome plate.
  7. Maximum Flow Rate: 0.5 gpm.
  8. Maximum Flow: 0.25 gal. per metering cycle.
  9. Mounting Type: Deck, exposed.
  10. Valve Handle(s): Single lever Push button.
  11. Spout: Rigid type.
  12. Spout Outlet: Laminar flow.

### 2.03 SUPPORTS

- A. Type II Lavatory Carrier:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Josam Company.
    - c. Zurn Industries, LLC.
  2. Standard: ASME A112.6.1M.

### 2.04 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
1. NPS 3/8.
  2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

### 2.05 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

- C. Trap:
1. Size: NPS 1-1/2 by NPS 1-1/4.
  2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.
  3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

#### **3.03 CONNECTIONS**

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

#### **3.04 ADJUSTING**

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

**3.05 CLEANING AND PROTECTION**

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

**END OF SECTION 224216.13**



**SECTION 224216.16****COMMERCIAL SINKS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
  - 1. Service basins.
  - 2. Service sinks.
  - 3. Utility sinks.
  - 4. Handwash sinks.
  - 5. Sink faucets.
  - 6. Laminar-flow, faucet-spout outlets.
  - 7. Supports.
  - 8. Supply fittings.
  - 9. Waste fittings.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

**1.04 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**PART 2 - PRODUCTS****2.01 SERVICE BASINS**

- A. Service Basins: Plastic, floor mounted.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Zurn Industries, LLC.
  - 2. Fixture:
    - a. Standard: IAPMO/ANSI Z124.6.
    - b. Material: Cast polymer.
    - c. Nominal Size: 24 by 24 by 10 inches.
    - d. Tiling Flange: Not required.
    - e. Rim Guard: On all top surfaces.
    - f. Color: Not applicable.
    - g. Drain: Grid with NPS 3 outlet.
  - 3. Mounting: On floor and flush to wall.

**2.02 SERVICE SINKS**

- A. Service Sinks: Enameled, cast iron, trap standard mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Zurn Industries, LLC.
2. Fixture:
  - a. Standard: ASME A112.19.1/CSA B45.2.
  - b. Type: Service sink with back.
  - c. Back: Two faucet holes.
  - d. Nominal Size: 36 by 20 inches.
  - e. Color: White.
  - f. Mounting: NPS 2 P-trap standard with grid strainer inlet, cleanout, and floor flange.
  - g. Rim Guard: On front and sides.
3. Support: Type II sink carrier..
4. Lavatory Mounting Height: Standard Handicapped/elderly according to ICC A117.1.

### 2.03 UTILITY SINKS

- A. Utility Sinks: Stainless steel, counter mounted.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Tabco.
    - b. Eagle Group.
    - c. Elkay Manufacturing Co.
    - d. Just Manufacturing.
  2. Fixture:
    - a. Standard: ASME A112.19.3/CSA B45.4.
    - b. Type: Ledge back.
    - c. Number of Compartments: One or Two.
    - d. Compartment:
      - 1) Drain: Grid with NPS 1-1/2 tailpiece and twist drain.
      - 2) Drain Location: Near back of compartment.
  3. Faucet(s) Number Required: One.
    - a. Mounting: On ledge.
  4. Supply Fittings:
    - a. Standard: ASME A112.18.1/CSA B125.1.
    - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      - 1) Operation: Loose key.
      - 2) Risers: NPS 1/2, ASME A112.18.6, braided or corrugated stainless-steel flexible hose.
  5. Waste Fittings:
    - a. Standard: ASME A112.18.2/CSA B125.2.
    - b. Trap(s):
      - 1) Size: NPS 1-1/2.
      - 2) Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.
      - 3) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.
    - c. Continuous Waste:
      - 1) Size: NPS 1-1/2.
      - 2) Material: Chrome-plated, 0.032-inch-thick brass tube.
  6. Mounting: On counter with sealant.

**2.04 HANDWASH SINKS**

- A. Handwash Sinks: Stainless steel, wall mounted.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Tabco.
    - b. Eagle Group.
    - c. Elkay Manufacturing Co.
    - d. Just Manufacturing.
  2. Fixture:
    - a. Standards: ASME A112.19.3/CSA B45.4 and NSF/ANSI 2.
    - b. Type: Basin with radius corners, back for faucet, and support brackets.
    - c. Nominal Size: 17 by 16 by 5 inches.
  3. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
  4. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
  5. Support: Type II sink carrier..
  6. Lavatory Mounting Height: Standard Handicapped/elderly according to ICC A117.1.

**2.05 SINK FAUCETS**

- A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: Manual type, two-lever-handle mixing valve.
1. Commercial, Solid-Brass Faucets:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) American Standard.
      - 2) Delta Faucet Company.
      - 3) Moen Incorporated.
  2. Standard: ASME A112.18.1/CSA B125.1.
  3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
  4. Body Type: Centerset.
  5. Body Material: Commercial, solid brass.
  6. Finish: Chrome plated.
  7. Maximum Flow Rate: 2.2 gpm.
  8. Handle(s): Wrist blade, 4 inches.
  9. Mounting Type: Deck, exposed.
  10. Spout Type: Rigid, solid brass Rigid, solid brass with wall brace Swing, round tubular Rigid gooseneck Swivel gooseneck.
  11. Vacuum Breaker: Required for hose outlet.
  12. Spout Outlet: Laminar flow Hose thread according to ASME B1.20.7 Spray.

**2.06 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS**

- A. NSF Standard: Comply with NSF 372 for faucet-spout-outlet materials that will be in contact with potable water.
- B. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

**2.07 SUPPORTS**

- A. Type II Sink Carrier:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Josam Company.
    - c. Zurn Industries, LLC.
  - 2. Standard: ASME A112.6.1M.

**2.08 SUPPLY FITTINGS**

- A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  - 1. NPS 3/8.
  - 2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

**2.09 WASTE FITTINGS**

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
  - 1. Size: NPS 1-1/2.
  - 2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall p-trap and chrome-plated brass or steel wall flange.

**PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION**

- A. Install sinks level and plumb according to roughing-in drawings.

- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
  - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
  - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### **3.03 CONNECTIONS**

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### **3.04 ADJUSTING**

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

### **3.05 CLEANING AND PROTECTION**

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

### **END OF SECTION 224216.16**

**SECTION 224716****PRESSURE WATER COOLERS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section includes pressure water coolers and related components.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of pressure water cooler.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

**1.03 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

**1.04 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 1 of each.

**PART 2 - PRODUCTS**

- A. Pressure Water Coolers: Wall mounted, standard, wheelchair accessible, bottle filler, vandal resistant .
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkay Manufacturing Co.
    - b. Halsey Taylor.
    - c. Oasis International.
  - 2. Standards:
    - a. Comply with NSF 61 and NSF 372.
    - b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
    - c. Comply with ICC A117.1.
  - 3. Cabinet: Bi-level with two attached cabinets, all stainless steel.
  - 4. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
  - 5. Control: Push button.
  - 6. Bottle Filler: Sensor activation with 20-second automatic shutoff timer. Fill rate 0.5 to 1.5 gpm.
  - 7. Drain: Grid with NPS 1-1/4 tailpiece.
  - 8. Supply: NPS 3/8 with shutoff valve.
  - 9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
  - 10. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.

11. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
  - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
12. Capacities and Characteristics:
  - a. Cooled Water: 8 gph.
  - b. Ambient-Air Temperature: 90 deg F.
  - c. Inlet-Water Temperature: 80 deg F.
  - d. Cooled-Water Temperature: 50 deg F.
13. Support: Type I water cooler carrier.
14. Water Cooler Mounting Height: Standard Handicapped/elderly according to ICC A117.1.

## 2.02 SUPPORTS

### A. Type I Water Cooler Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

### 2.03 Bottle Filling Station: In-wall mounted.

1. Standards:
  - a. Comply with NSF 61 and NSF 372.
  - b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
  - c. Comply with ICC A117.1.
2. Cabinet: All stainless steel.
3. **Bottle filler: Sensor.**
4. Drain: Grid with NPS 1-1/4 (DN 32) tailpiece.
5. Supply: NPS 3/8 (DN 10) with shutoff valve.
6. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) brass P-trap.
7. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
8. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
  - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
9. Capacities and Characteristics:
  - a. Cooled Water: 8 gph (0.0084 L/s).
  - b. Ambient-Air Temperature: 90 deg F (32 deg C).
  - c. Inlet-Water Temperature: 80 deg F (27 deg C).
  - d. Cooled-Water Temperature: 50 deg F (10 deg C).
  - e. Electrical Characteristics:
    - 1) Volts: 115-V ac.
    - 2) Phase: Single.
    - 3) Hertz: 60.
    - 4) Full-Load Amperes: 1
10. Ventilation Grille: Stainless steel.
11. Support: Mounting frame for attaching to substrate.

**PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION**

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set freestanding pressure water coolers on floor.
- C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- D. Install mounting frames, affixed to building construction, and attach in-wall bottle filling stations to mounting frames.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

**3.03 CONNECTIONS**

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."



**3.04 ADJUSTING**

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

**3.05 CLEANING**

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

**END OF SECTION 224716**

**SECTION 230517****SLEEVES AND SLEEVE SEALS FOR HVAC PIPING****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.
  - 6. Silicone sealants.
- B. Related Requirements:
  - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**PART 2 - PRODUCTS****2.01 SLEEVES**

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
- E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

**2.02 STACK-SLEEVE FITTINGS**

- A. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with setscrews.

**2.03 SLEEVE-SEAL SYSTEMS**

- A. Description:
1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  2. Designed to form a hydrostatic seal of 20-psig (137-kPa) minimum).
  3. Sealing Elements: EPDM-rubber, High-temperature-silicone or Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
  4. Pressure Plates: Carbon steel, Composite plastic or Stainless steel, Type 316.
  5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 or Stainless steel of length required to secure pressure plates to sealing elements.

**2.04 SLEEVE-SEAL FITTINGS**

- A. Description:
1. Manufactured plastic, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.
  2. Plastic or rubber waterstop collar with center opening to match piping OD.

**2.05 GROUT**

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

**2.06 SILICONE SEALANTS**

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

**PART 3 - EXECUTION****3.01 SLEEVE INSTALLATION**

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
  - 3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

**3.02 STACK-SLEEVE-FITTING INSTALLATION**

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 3 inches (76 mm) above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using waterproof silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
- B. Fire-Resistance-Rated, Horizontal Assembly, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

**3.03 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

**3.04 SLEEVE-SEAL-FITTING INSTALLATION**

- A. Install sleeve-seal fittings as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeve-seal fittings.

**3.05 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

**3.06 SLEEVE AND SLEEVE-SEAL SCHEDULE**

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls Above Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron sleeves, Galvanized-steel pipe sleeves or Sleeve-seal fittings.
    - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves or Galvanized-steel pipe sleeves.
  - 2. Exterior Concrete Walls Below Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system, Galvanized-steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 (DN 150)] and Larger: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system, Galvanized-steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

- b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system. Galvanized-steel pipe sleeves with sleeve-seal system.
  - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
- 4. Concrete Slabs Above Grade:
  - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel pipe sleeves, Sleeve-seal fittings or Molded-PE or -PP sleeves.
  - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel pipe sleeves.
- 5. Interior Partitions:
  - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel pipe sleeves.
  - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel sheet sleeves.

**END OF SECTION 230517**

**SECTION 230529****HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Fiberglass pipe hangers.
  - 4. Metal framing systems.
  - 5. Fiberglass strut systems.
  - 6. Thermal-hanger shield inserts.
  - 7. Fastener systems.
  - 8. Pipe stands.
  - 9. Equipment supports.
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
  - 3. Section 233113 "Metal Ducts" for duct hangers and supports.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Fiberglass strut systems.
  - 4. Pipe stands.
  - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Include design calculations for designing trapeze hangers.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

**1.05 QUALITY ASSURANCE**

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment.

**2.02 METAL PIPE HANGERS AND SUPPORTS**

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe and Tube Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel.

**2.03 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.
- B. MFMA Manufacturer Metal Framing Systems:
  - 1. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.



2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channels: Continuous slotted steel channel with inturred lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc or Hot-dip galvanized.

#### 2.04 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with **100-psi (688-kPa)** or ASTM C591, Type VI, Grade 1 polyisocyanurate with **125-psi (862-kPa)** minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with **100-psi (688-kPa)**, ASTM C552, Type II cellular glass with **100-psi (688-kPa)** or ASTM C591, Type VI, Grade 1 polyisocyanurate with **125-psi (862-kPa)** minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend **2 inches (50 mm)** beyond sheet metal shield for piping operating below ambient air temperature.

#### 2.05 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

#### 2.06 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
  1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  3. Hardware: Galvanized steel or polycarbonate.
  4. Accessories: Protection pads.
- C. Low-Profile, Single Base, Single-Pipe Stand:
  1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
  2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  3. Vertical Members: Two, galvanized or stainless-steel, continuous-thread 1/2-inch (12-mm) rods.

4. Horizontal Member: Adjustable horizontal, galvanized or stainless-steel pipe support channels.
  5. Hardware: Galvanized or Stainless steel.
  6. Accessories: Protection pads.
  7. Height: 12 inches (300 mm) above roof.
- D. High-Profile, Single Base, Single-Pipe Stand:
1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  2. Base: Single vulcanized rubber or molded polypropylene.
  3. Vertical Members: Two, galvanized or stainless-steel, continuous-thread 1/2-inch (12-mm) rods.
  4. Horizontal Member: One, adjustable height, galvanized-or stainless-steel pipe support slotted channel or plate.
  5. Pipe Supports: Roller, Clevis hanger or Swivel hanger.
  6. Hardware: Galvanized or Stainless steel.
- E. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## **2.07 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## **2.08 MATERIALS**

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi 28-day compressive strength.

## **PART 3 - EXECUTION**

### **3.01 APPLICATION**

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum

static design load used for strength determination shall be weight of supported components plus 200 lb.

### **3.02 HANGER AND SUPPORT INSTALLATION**

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- O. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2 12 inches long and 0.048 inch thick.
    - b. NPS 4 : 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14 : 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.03 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.04 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.05 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.06 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide a minimum dry film thickness of **2.0 mils**.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.07 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to **1050 deg F (566 deg C)**, pipes **NPS 4 to NPS 24 (DN 100 to DN 600)**, requiring up to **4 inches (100 mm)** of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36 (DN 20 to DN 900)**, requiring clamp flexibility and up to **4 inches (100 mm)** of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24 (DN 15 to DN 600)** if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4 (DN 15 to DN 100)**, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8 (DN 20 to DN 200)**.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8 (DN 10 to DN 200)**.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3 (DN 10 to DN 80)**.
  12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36 (DN 65 to DN 900)** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30 (DN 25 to DN 750)**, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24 (DN 65 to DN 600)**, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42 (DN 50 to DN 1050)** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24 (DN 50 to DN 600)** if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30 (DN 50 to DN 750)** if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24 (DN 24 to DN 600)**.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24 (DN 20 to DN 600)** if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to **6 inches (150 mm)** for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb (340 kg).
    - b. Medium (MSS Type 32): 1500 lb (680 kg).
    - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

**END OF SECTION 230529**



**SECTION 230548.13****VIBRATION CONTROLS FOR HVAC****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Elastomeric isolation pads.
  2. Elastomeric isolation mounts.
  3. Restrained elastomeric isolation mounts.
  4. Open-spring isolators.
  5. Housed-spring isolators.
  6. Restrained-spring isolators.
  7. Housed-restrained-spring isolators.
  8. Pipe-riser resilient supports.
  9. Resilient pipe guides.
  10. Elastomeric hangers.
  11. Spring hangers.
  12. Vibration isolation equipment bases.
  13. Restrained isolation roof-curb rails.
- B. Related Requirements:
1. Section 210548.13 "Vibration Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
  2. Section 220548.13 "Vibration Controls for Plumbing" for devices for plumbing equipment and systems.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
- B. Shop Drawings:
1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation device.
1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data.

**1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For restrained-air-spring mounts to include in operation and maintenance manuals.

**1.06 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

**PART 2 - PRODUCTS****2.01 ELASTOMERIC ISOLATION PADS**

- A. Elastomeric Isolation Pads:
  - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 2. Size: Factory or field cut to match requirements of supported equipment.
  - 3. Pad Material: Oil and water resistant with elastomeric properties.
  - 4. Surface Pattern: Ribbed pattern.
  - 5. Infused nonwoven cotton or synthetic fibers.
  - 6. Load-bearing metal plates adhered to pads.
  - 7. Sandwich-Core Material: Resilient and elastomeric.
    - a. Surface Pattern: Ribbed or Waffle pattern.
    - b. Infused nonwoven cotton or synthetic fibers.

**2.02 ELASTOMERIC ISOLATION MOUNTS**

- A. Double-Deflection, Elastomeric Isolation Mounts:
  - 1. Mounting Plates:
    - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
    - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
  - 2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

**2.03 RESTRAINED ELASTOMERIC ISOLATION MOUNTS**

- A. Restrained Elastomeric Isolation Mounts:

1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  - a. Housing: Cast-ductile iron or welded steel.
  - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## **2.04 OPEN-SPRING ISOLATORS**

- A. Freestanding, Laterally Stable, Open-Spring Isolators:
  1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
  6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

## **2.05 HOUSED-SPRING ISOLATORS**

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
  1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top housing with threaded mounting holes and internal leveling device and elastomeric pad.

## **2.06 RESTRAINED-SPRING ISOLATORS**

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
  1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top plate with threaded mounting holes and elastomeric pad.
    - c. Internal leveling bolt that acts as blocking during installation.
  2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

**2.07 HOUSED-RESTRAINED-SPRING ISOLATORS**

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

**2.08 PIPE-RISER RESILIENT SUPPORT**

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

**2.09 RESILIENT PIPE GUIDES**

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

**2.10 ELASTOMERIC HANGERS**

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

**2.11 SPRING HANGERS**

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.12 VIBRATION ISOLATION EQUIPMENT BASES

- A. Steel Rails: Factory-fabricated, welded, structural-steel rails.
  1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
    - a. Include supports for suction and discharge elbows for pumps.
  2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
  3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
  1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
  3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Concrete Inertia Base: field-fabricated welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
  1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
  3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
  4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

## 2.13 RESTRAINED ISOLATION ROOF-CURB RAILS

- A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.
- B. Upper Frame: Upper frame shall provide continuous and captive support for equipment.
- C. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches of rigid glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric

vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

- D. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- E. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 VIBRATION CONTROL DEVICE INSTALLATION**

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

#### **3.03 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION**

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

**END OF SECTION 230548.13**

**SECTION 230553****IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.
  4. Duct labels.
  5. Stencils.
  6. Warning tags.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

**PART 2 - PRODUCTS****2.01 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  1. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch .
  3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  4. Fasteners: Stainless-steel rivets or self-tapping screws.
  5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) or 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
  2. Letter Color: White or Yellow
  3. Background Color: Black White Yellow.
  4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
  6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## **2.02 WARNING SIGNS AND LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White or Yellow
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch .
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

## **2.03 DUCT LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.



- B. Letter Color: White or Yellow
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch .
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches , 1/2 inch for viewing distances up to 72 inches , and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

#### **2.04 STENCILS**

- A. Stencils for Ducts:
  - 1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
  - 2. Stencil Material: Fiberboard or metal.
  - 3. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
  - 4. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.
- B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
  - 1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
  - 2. Stencil Material: Fiberboard or metal.
  - 3. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
  - 4. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.

#### **2.05 WARNING TAGS**

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum. Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Safety-yellow background with black lettering.

**PART 3 - EXECUTION****3.01 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

**3.02 GENERAL INSTALLATION REQUIREMENTS**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

**3.03 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

**3.04 PIPE LABEL INSTALLATION**

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting" or Section 099600 "High-Performance Coatings."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule:
  - 1. Heating Water Piping: White letters on a safety-green background or Black letters on a safety-orange background.

2. Refrigerant Piping: Black letters on a safety-orange background, White letters on a safety-purple background, Black letters on a safety-white background, White letters on a safety-gray background or White letters on a safety-black background.

### **3.05 DUCT LABEL INSTALLATION**

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  1. Blue: For cold-air supply ducts.
  2. Yellow For hot-air supply ducts.
  3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

### **3.06 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  1. Valve-Tag Size and Shape:
    - a. Refrigerant: 1-1/2 inches (38 mm) or 2 inches (50 mm), round or square.
    - b. Heating Water: 1-1/2 inches (38 mm) or 2 inches (50 mm), round or square.
  2. Valve-Tag Colors:
    - a. Potable and Other Water: White letters on a safety-green background.

### **3.07 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 230553**

**SECTION 230593****TESTING, ADJUSTING, AND BALANCING FOR HVAC****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Testing, Adjusting, and Balancing of Air Systems:
    - a. Constant-volume air systems.

**1.03 DEFINITIONS.**

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: Within 45 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Certified TAB reports.
- D. Sample report forms.
- E. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

**1.05 QUALITY ASSURANCE**

- A. TAB Specialists Qualifications, Certified by AABC or NEBB:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB.

- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

#### **1.06 FIELD CONDITIONS**

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

#### **PART 2 - PRODUCTS (Not Applicable)**

#### **PART 3 - EXECUTION**

##### **3.01 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.02 PREPARATION**

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.

### **3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
  - 3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.

4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 23 "HVAC Insulation".
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### **3.04 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT**

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
  1. Motors.
  2. Pumps.
  3. Fans and ventilators..
  4. Terminal units.
  5. Furnaces.
  6. Radiant heaters.
  7. Unit heaters.
  8. Condensing units..
  9. Air-handling units.
  10. Heating and ventilating units..
  11. Split-system air conditioners.
  12. Heat pumps..
  13. Coils.
  14. Fan coil units.
  15. Unit ventilators.

### **3.05 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

**3.06 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  4. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlets and outlets airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  2. Re-measure and confirm that total airflow is within design.
  3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
  4. Mark all final settings.
  5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  6. Measure and record all operating data.
  7. Record final fan-performance data.

**3.07 PROCEDURES FOR AIR-COOLED CONDENSING UNITS**

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.



- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of compressor(s), fan(s), and motors.

### **3.08 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Air pressure drop.
  - 5. Voltage and amperage input of each phase at full load.
  - 6. Calculated kilowatt at full load.
  - 7. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.
  - 4. Air pressure drop.
  - 5. Entering and leaving refrigerant pressure and temperatures.

### **3.09 DUCT LEAKAGE TESTS**

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

### **3.10 HVAC CONTROLS VERIFICATION.**

- A. In conjunction with system balancing, perform the following:
  - 1. Verify HVAC control system is operating within the design limitations.
  - 2. Confirm that the sequences of operation are in compliance with Contract Documents.
  - 3. Verify that controllers are calibrated and function as intended.
  - 4. Verify that controller set points are as indicated.
  - 5. Verify the operation of lockout or interlock systems.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

### **3.11 TOLERANCES**

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent
  - 2. Air Outlets and Inlets: Plus or minus 10 percent
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### **3.12 PROGRESS REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-

balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.13 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
  3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB specialist.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents, including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans performance forms, including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Heating coil, dry-bulb conditions.
    - e. Face and bypass damper settings at coils.
    - f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    - g. Other system operating conditions that affect performance.

- D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Duct, outlet, and inlet sizes.
  3. Terminal units.
  4. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and speed.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan speed.
    - d. Inlet and discharge static pressure in inches wg.
    - e. For each filter bank, filter static-pressure differential in inches wg.
    - f. Preheat-coil static-pressure differential in inches wg.
    - g. Cooling-coil static-pressure differential in inches wg.
    - h. Heating-coil static-pressure differential in inches wg.
    - i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
    - j. Outdoor airflow in cfm.
    - k. Return airflow in cfm.
    - l. Outdoor-air damper position.
    - m. Return-air damper position.
- F. Apparatus-Coil Test Reports:
1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.
    - d. Number of rows.
    - e. Fin spacing in fins per inch o.c.
    - f. Make and model number.
    - g. Face area in sq. ft..
    - h. Tube size in NPS.
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Refrigerant expansion valve and refrigerant types.
  - i. Refrigerant suction pressure in psig.
  - j. Refrigerant suction temperature in deg F.
- G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Fuel type in input data.
    - g. Output capacity in Btu/h.
    - h. Ignition type.
    - i. Burner-control types.
    - j. Motor horsepower and speed.
    - k. Motor volts, phase, and hertz.
    - l. Motor full-load amperage and service factor.
    - m. Sheave make, size in inches, and bore.
    - n. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - 2. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Entering-air temperature in deg F.
    - c. Leaving-air temperature in deg F.
    - d. Air temperature differential in deg F.
    - e. Entering-air static pressure in inches wg.
    - f. Leaving-air static pressure in inches wg.
    - g. Air static-pressure differential in inches wg.
    - h. Low-fire fuel input in Btu/h.
    - i. High-fire fuel input in Btu/h.
    - j. Manifold pressure in psig .
    - k. High-temperature-limit setting in deg F.
    - l. Operating set point in Btu/h.
    - m. Motor voltage at each connection.
    - n. Motor amperage for each phase.
    - o. Heating value of fuel in Btu/h.
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
- 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in Btu/h.
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Airflow rate in cfm.

- i. Face area in sq. ft..
      - j. Minimum face velocity in fpm.
    2. Test Data (Indicated and Actual Values):
      - a. Heat output in Btu/h.
      - b. Airflow rate in cfm.
      - c. Air velocity in fpm.
      - d. Entering-air temperature in deg F.
      - e. Leaving-air temperature in deg F.
      - f. Voltage at each connection.
      - g. Amperage for each phase.
  - I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
    1. Fan Data:
      - a. System identification.
      - b. Location.
      - c. Make and type.
      - d. Model number and size.
      - e. Manufacturer's serial number.
      - f. Arrangement and class.
      - g. Sheave make, size in inches, and bore.
      - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
    2. Motor Data:
      - a. Motor make, and frame type and size.
      - b. Horsepower and speed.
      - c. Volts, phase, and hertz.
      - d. Full-load amperage and service factor.
      - e. Sheave make, size in inches, and bore.
      - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
      - g. Number, make, and size of belts.
    3. Test Data (Indicated and Actual Values):
      - a. Total airflow rate in cfm.
      - b. Total system static pressure in inches wg.
      - c. Fan speed.
      - d. Discharge static pressure in inches wg.
      - e. Suction static pressure in inches wg.
  - J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
    1. Report Data:
      - a. System fan and air-handling-unit number.
      - b. Location and zone.
      - c. Traverse air temperature in deg F.
      - d. Duct static pressure in inches wg.
      - e. Duct size in inches.
      - f. Duct area in sq. ft. .
      - g. Indicated airflow rate in cfm .
      - h. Indicated velocity in fpm.
      - i. Actual airflow rate in cfm.
      - j. Actual average velocity in fpm.
      - k. Barometric pressure in psig.
  - K. Air-Terminal-Device Reports:
    1. Unit Data:
      - a. System and air-handling unit identification.
      - b. Location and zone.
      - c. Apparatus used for test.

- d. Area served.
  - e. Make.
  - f. Number from system diagram.
  - g. Type and model number.
  - h. Size.
  - i. Effective area in sq. ft..
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
  - b. Air velocity in fpm.
  - c. Preliminary airflow rate as needed in cfm.
  - d. Preliminary velocity as needed in fpm.
  - e. Final airflow rate in cfm.
  - f. Final velocity in fpm.
  - g. Space temperature in deg F.
- L. Instrument Calibration Reports:
- 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### **3.14 VERIFICATION OF TAB REPORT**

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 25 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
  - 2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

### **3.15 ADDITIONAL TESTS**

- A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

**END OF SECTION 230593**

**SECTION 230713****DUCT INSULATION****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section includes insulating the following duct services:
  1. Indoor, concealed supply and outdoor air.
  2. Indoor, exposed supply and outdoor air.
  3. Indoor, concealed return located in unconditioned space.
  4. Indoor, exposed return located in unconditioned space.
  5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  7. Outdoor, concealed supply and return.
  8. Outdoor, exposed supply and return.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  3. Detail application of field-applied jackets.
  4. Detail application at linkages of control devices.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

**1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.



- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### **1.07 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 Hangers and Supports for HVAC Piping and Equipment.
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### **1.08 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### **PART 2 - PRODUCTS**

#### **2.01 INSULATION MATERIALS**

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type II for sheet materials.
  - 1. Areoflex USA
  - 2. Armacell LLC
  - 3. K-Flex USA.
  
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. CertainTeed Corp.
  - 2. Johns Manville
  - 3. Knauf Insulation

## 2.02 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C656, Type II, Grade 6. Tested and certified to provide a 1 or 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. Johns Manville
  
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1 or 2 hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. 3m
  - 2. Thermal Ceramics
  - 3. Unifrax Corporation

## 2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
  
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aero seal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.04 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
    - b. Eagle Bridges - Marathon Industries; 501.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
    - d. Mon-Eco Industries, Inc.; 55-10.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
  3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.

- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Eagle Bridges - Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. Vimasco Corporation; WC-1/WC-5.
  - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  - 4. Solids Content: 60 percent by volume and 66 percent by weight.
  - 5. Color: White.

## 2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    - c. Vimasco Corporation; 713 and 714.
  - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  - 4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
  - 5. Color: White.

## 2.06 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Eagle Bridges - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - d. Mon-Eco Industries, Inc.; 44-05.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  - 5. Color: Aluminum..
  - 6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.07 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
  4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
  5. Vinyl Jacket: White vinyl with a permeance of **1.3 perms (0.86 metric perm)** when tested according to ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
    - b. Vimasco Corporation; Elastafab 894.

## 2.09 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

## 2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.

- d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
- D. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Finish and thickness are indicated in field-applied jacket schedules.
    - b. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
    - c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper of 2.5-mil- (0.063-mm-) thick polysurlyn.
- E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Polyguard Products, Inc.; Alumaguard 60.

## 2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 11.5 mils (0.29 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 6.5 mils (0.16 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Width: 2 inches (50 mm).
  3. Thickness: 6 mils (0.15 mm).
  4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches (50 mm).
  3. Thickness: 3.7 mils (0.093 mm).
  4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

## 2.12 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ITW Insulation Systems; Gerrard Strapping and Seals.
    - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
  2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal or closed seal.
  3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; CD.
      - 3) Midwest Fasteners, Inc.; CD.
      - 4) Nelson Stud Welding; TPA, TPC, and TPS.
  2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; CHP-1.
      - 2) GEMCO; Cupped Head Weld Pin.
      - 3) Midwest Fasteners, Inc.; Cupped Head.
      - 4) Nelson Stud Welding; CHP.
  3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in

position indicated when self-locking washer is in place. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.062-inch (1.6-mm) soft-annealed, galvanized steel.
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
    - a. C & F Wire.

## 2.13 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.



- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least **2 inches (50 mm)**.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least **2 inches (50 mm)**.
  2. Seal penetrations through fire-rated assemblies.

### 3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.06 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

- b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
  5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

### 3.07 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

### 3.08 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.

- C. Install firestopping at penetrations through fire-rated assemblies.

### **3.09 FINISHES**

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### **3.10 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.11 DUCT INSULATION SCHEDULE, GENERAL**

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 7. Outdoor, concealed supply and return.
  - 8. Outdoor, exposed supply and return.
- B. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 3. Factory-insulated flexible ducts.
  - 4. Factory-insulated plenums and casings.
  - 5. Flexible connectors.
  - 6. Vibration-control devices.
  - 7. Factory-insulated access panels and doors.

### **3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE**

- A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.

2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- C. Concealed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- D. Concealed, round and flat-oval, exhaust-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- E. Concealed, rectangular, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- F. Concealed, rectangular, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- G. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- H. Concealed, supply-air plenum insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch (25 mm) thick.

2. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  3. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  4. Polyolefin: 1 inch (25 mm) thick.
- I. Concealed, return-air plenum insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch (25 mm) thick.
  2. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  3. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  4. Polyolefin: 1 inch (25 mm) thick.
- J. Concealed, outdoor-air plenum insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch (25 mm) thick.
  2. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  3. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  4. Polyolefin: 1 inch (25 mm) thick.
- K. Concealed, exhaust-air plenum insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch (25 mm) thick.
  2. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  3. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  4. Polyolefin: 1 inch (25 mm) thick.
- L. Exposed, round and flat-oval, supply-air duct insulation shall be one of the following:
1. Double walled duct shall have interstitial insulation as specified in the section 233113 Metal Ducts.
  2. Single walled duct:
    - a. No insulation required if temperature difference between supply air inside duct and room temperature is 10 deg. F. or less.
    - b. Flexible Elastomeric: 1 inch (25 mm) thick.
    - c. Polyolefin: 1 inch (25 mm) thick.
- M. Exposed, round and flat-oval, return-air duct insulation shall be:
1. No insulation required.
- N. Exposed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
1. Double walled duct shall have interstitial insulation as specified in the section 233113 Metal Ducts.
  2. Single walled duct:
    - a. No insulation required if temperature difference between supply air inside duct and room temperature is 10 deg. F. or less.

- b. Flexible Elastomeric: 1 inch (25 mm) thick.
- 3. Polyolefin: 1 inch (25 mm) thick.
  
- O. Exposed, round and flat-oval, exhaust-air duct insulation shall be:
  - 1. No insulation required.
  
- P. Exposed, rectangular, supply-air duct insulation shall be one of the following:
  - 1. Flexible Elastomeric: 1 inch (25 mm) thick.
  - 2. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  - 3. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  - 4. Polyolefin: 1 inch (25 mm) thick.
  
- Q. Exposed, rectangular, return-air duct insulation shall be:
  - 1. No insulation required.
  
- R. Exposed, rectangular, outdoor-air duct insulation shall be one of the following:
  - 1. Flexible Elastomeric: 1 inch (25 mm) thick.
  - 2. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  - 3. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  - 4. Polyolefin: 1 inch (25 mm) thick.
  
- S. Exposed, rectangular, exhaust-air duct insulation shall be:
  - 1. No insulation required.
  
- T. Exposed, supply-air plenum insulation shall be one of the following:
  - 1. Flexible Elastomeric: 1 inch (25 mm) thick.
  - 2. Polyolefin: 1 inch (25 mm) thick.
  
- U. Exposed, return-air plenum insulation shall be one of the following:
  - 1. No insulation required.
  
- V. Exposed, outdoor-air plenum insulation shall be one of the following:
  - 1. Flexible Elastomeric: 1 inch (25 mm) thick.
  - 2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  - 3. Polyolefin: 1 inch (25 mm) thick.
  
- W. Exposed, exhaust-air plenum insulation shall be:
  - 1. No insulation required.

### **3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE**

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
  
- B. Exposed, round, supply-air duct insulation shall be one of the following:



1. Flexible Elastomeric: 1-1/2 inches (38 mm) thick.
  2. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  3. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  4. Polyolefin: 1-1/2 inches (38 mm) thick.
- C. Exposed, round, return-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1-1/2 inches (38 mm) thick.
  2. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  3. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  4. Polyolefin: 1-1/2 inches (38 mm) thick.
- D. Exposed, rectangular, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  2. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
- E. Exposed, rectangular, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  2. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
- F. Exposed, supply-air plenum insulation shall be one of the following:
1. Flexible Elastomeric: 1-1/2 inches (38 mm) thick.
  2. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  3. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  4. Polyolefin: 1-1/2 inches (38 mm) thick.
- G. Exposed, return-air plenum insulation shall be one of the following:
1. Flexible Elastomeric: 1-1/2 inches (38 mm) thick.
  2. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  3. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
  4. Polyolefin: 1-1/2 inches (38 mm) thick.

### 3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Ducts and Plenums, Concealed:
  - 1. None.
  
- D. Ducts and Plenums, Exposed, ABOVE 5':
  - 1. PVC: 20 mils (0.5 mm) thick.
  - 2. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.020 inch (0.51 mm) thick.
  - 3. Painted Aluminum, Smooth, Corrugated or Stucco Embossed: 0.020 inch (0.51 mm) thick.
  
- E. Ducts and Plenums, Exposed, BELOW 5':
  - 1. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch (0.81 mm) thick.
  - 2. Painted Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch (0.81 mm) thick.

### **3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  
- B. If more than one material is listed, selection from materials listed is Contractor's option.
  
- C. Ducts and Plenums, Concealed:
  - 1. PVC, Color-Coded by System: 20 mils (0.5 mm) thick.
  
- D. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
  - 1. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch (0.81 mm) thick.
  - 2. Painted Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch (0.81 mm) thick.
  
- E. Ducts and Plenums, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
  - 1. Aluminum, Smooth or Stucco Embossed with 1-1/4-Inch- (32-mm-) Deep Corrugations.

### **END OF SECTION 230713**

**SECTION 230716****HVAC EQUIPMENT INSULATION****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section includes insulating HVAC equipment that is not factory insulated.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation."
  - 2. Section 230719 "HVAC Piping Insulation."

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail removable insulation at equipment connections.
  - 2. Detail application of field-applied jackets.
  - 3. Detail application at linkages of control devices.
  - 4. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
  - 1. Sheet Form Insulation Materials: 12 inches square.
  - 2. Sheet Jacket Materials: 12 inches square.
  - 3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

**1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
- C. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### **1.07 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

#### **1.08 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### **PART 2 - PRODUCTS**

#### **2.01 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### **2.02 INSULATION MATERIALS**

- A. Comply with requirements in "Breeching Insulation Schedule," "Indoor Equipment Insulation Schedule," and "Outdoor, Aboveground Equipment Insulation Schedule?" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I or Type II.
  - 1. Prefabricated Fitting Covers: Comply with ASTM C450 and ASTM C585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
  - 1. Block Insulation: Type I.
  - 2. Special-Shaped Insulation: Type III.
  - 3. Board Insulation: Type IV.
  - 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type II for sheet materials.
- I. Mineral-Fiber Blanket: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II, and ASTM C1290, Type III, with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. High-Temperature, Mineral-Fiber Blanket: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type V, without factory-applied jacket.
- K. Mineral-Fiber Board: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. Provide insulation factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- L. High-Temperature, Mineral-Fiber Board: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type III, without factory-applied jacket.
- M. Polyisocyanurate: Preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation. Comply with ASTM C591.
  - 1. Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
  - 2. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thicknesses of up to 1 inch as tested in accordance with ASTM E84.
  - 3. Fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 4. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
    - a. Equipment Applications: ASJ-SSL.
- N. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type II, Grade 1 for sheet materials.
- O. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C578, Type IV or VIII.

1. Fabricate shapes in accordance with ASTM C450 and ASTM C585.

### **2.03 INSULATING CEMENTS**

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

### **2.04 ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
- D. Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
- E. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
  1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  2. Wet Flash Point: Below 0 deg F.
  3. Service Temperature Range: 40 to 200 deg F.
  4. Color: Black
- F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
- H. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- I. PVC Jacket Adhesive: Compatible with PVC jacket.

### **2.05 MASTICS AND COATINGS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor and outdoor use on below-ambient services.
  1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: 0 to plus 180 deg F
  3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
  4. Color: White
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
  1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.

2. Service Temperature Range: 0 to 180 deg F.
  3. Color: White
- D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: Minus 50 to plus 220 deg F.
  3. Color: White
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  2. Service Temperature Range: 0 to plus 180 deg F.
  3. Color: White.

## 2.06 LAGGING ADHESIVES

- A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
  2. Service Temperature Range: 20 to plus 180 deg F
  3. Color: White.

## 2.07 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
1. Permanently flexible, elastomeric sealant.
  2. Service Temperature Range: Minus 58 to plus 176 deg F.
  3. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
1. Fire- and water-resistant, flexible, elastomeric sealant.
  2. Service Temperature Range: Minus 40 to plus 250 deg F.
  3. Color: Aluminum.
- D. ASJ Flashing Sealants and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Fire- and water-resistant, flexible, elastomeric sealant.
  2. Service Temperature Range: Minus 40 to plus 250 deg F.
  3. Color: White.

## 2.08 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

4. Vinyl Jacket: White vinyl with a permeance of **1.3 perms** when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## **2.09 FIELD-APPLIED FABRIC-REINFORCING MESH**

- A. Woven Glass-Fiber Fabric: Approximately 4 oz./sq. yd. (114 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering equipment.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment.

## **2.10 FIELD-APPLIED CLOTHS**

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

## **2.11 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Adhesive: As recommended by jacket material manufacturer.
  2. Color: White.
  3. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:
  1. Aluminum Jacket: Comply with ASTM B20, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- (0.063-mm-) thick polysurlyn.
    - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper or 2.5-mil- (0.063-mm-) thick polysurlyn.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.



- F. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.
- G. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested in accordance with ASTM E96/E96M and with a flame-spread index of 25 and a smoke-developed index of 50 when tested in accordance with ASTM E84.
- H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

## 2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
  - 1. Width: 3 inches
  - 2. Thickness: 11.5 mils
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
  - 1. Width: 3 inches
  - 2. Thickness: 6.5 mils
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Width: 2 inches
  - 2. Thickness: 6 mils
  - 3. Adhesion: 64 ounces force/inch in width.
  - 4. Elongation: 500 percent.
  - 5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Width: 2 inches
  - 2. Thickness: 3.7 mils
  - 3. Adhesion: 100 ounces force/inch in width.
  - 4. Elongation: 5 percent.
  - 5. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
  - 1. Width: 3 inches
  - 2. Film Thickness: 6 mils
  - 3. Adhesive Thickness: 1.5 mils
  - 4. Elongation at Break: 145 percent.
  - 5. Tensile Strength: 55 psi in width.

- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Width: 3 inches
  2. Film Thickness: 6 mils
  3. Adhesive Thickness: 1.5 mils
  4. Elongation at Break: 145 percent.
  5. Tensile Strength: 55 psi in width.

## 2.13 SECUREMENTS

- A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
  2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal .
  3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding; 0.106-inch diameter shank, length to suit depth of insulation indicated.
  2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
    - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - b. Spindle: Copper- or zinc-coated, low-carbon steel fully annealed, 0.106-inch-diameter shank; length to suit depth of insulation indicated.
    - c. Adhesive: Recommended by hanger manufacturer. Use product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  3. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
    - a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    - b. Spindle: Nylon, 0.106-inch- diameter shank; length to suit depth of insulation indicated, up to 2-1/2 inches .
    - c. Adhesive: Recommended by hanger manufacturer. Use product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
    - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed; 0.106-inch-diameter shank; length to suit depth of insulation indicated.
    - c. Adhesive-backed base with a peel-off protective cover.
  5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches) in diameter.
    - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.

#### **2.14 CORNER ANGLES**

- A. PVC Corner Angles: 30-mils- thick, minimum 1- by 1-inch PVC in accordance with ASTM D1784, Class 16354-C, white or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040-inch- thick, minimum 1- by 1-inch aluminum in accordance with ASTM B209 , Alloy 3003, 3005, 3105, or 5005; Temper H-14.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 PREPARATION**

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F . Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

#### **3.03 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, and jackets, of thicknesses required for each item of equipment, as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches . Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- O. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.

2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

### **3.04 INSTALLATION OF CALCIUM SILICATE INSULATION**

- A. Insulation Installation on Boiler Breechings:
1. Secure single-layer insulation with stainless steel bands at 12-inch (300-mm) intervals, and tighten bands without deforming insulation material.
  2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless steel bands at 12-inch (300-mm) intervals.
  3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

### **3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.06 FIELD-APPLIED JACKET INSTALLATION**

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches (300 mm) o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### **3.07 FINISHES**

- A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### **3.08 FIELD QUALITY CONTROL**

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in "Indoor Equipment Insulation Schedule" and "Outdoor, Aboveground Equipment Insulation Schedule?" articles. For large equipment, remove only a portion adequate to determine compliance.
- F. All insulation applications will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

### **3.09 EQUIPMENT INSULATION SCHEDULE, GENERAL**

- A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. Acceptable insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials is Contractor's option.

**3.10 INDOOR EQUIPMENT INSULATION SCHEDULE**

- A. Insulate indoor and outdoor equipment that is not factory insulated.

**3.11 OUTDOOR, ABOVEGROUND EQUIPMENT INSULATION SCHEDULE**

- A. Insulate indoor and outdoor equipment that is not factory insulated.

**3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
  - 1. Painted Aluminum, Smooth or Stucco Embossed: 0.016 inch thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces of up to 72 Inches.
  - 1. Painted Aluminum, Smooth or Stucco Embossed: 0.020 inch thick.

**3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
  - 1. Painted Aluminum, Smooth or Stucco Embossed: 0.016 inch thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces of up to 72 Inches.
  - 1. Painted Aluminum, Smooth or Stucco Embossed: 0.020 inch thick.

**END OF SECTION 230716**

**SECTION 230923****DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. DDC system for monitoring and controlling of HVAC systems. BACnet compliant
  - 2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.
  - 3. Programming and Graphics
  - 4. Controllers (Global, Standalone, Application Specific)
  - 5. Communications
- B. Related Requirements:
  - 1. Section 230993.11 "Sequence of Operations for HVAC DDC" for control sequences in DDC systems.
  - 2. Section 230923.12 - Control Dampers
  - 3. Section 230923.23 - Pressure Instruments
  - 4. Section 230923.27 - Temperature Instruments
  - 5. Communications Cabling:
    - a. Section 260523 "Control-Voltage Electrical Power Cables" for balanced twisted pair communications cable.
    - b. Section 271513 "Communications Copper Horizontal Cabling" for balanced twisted pair communications cable.

- 1.03 **CODES AND REFERENCE STANDARDS:** The latest edition of the following standards and codes in effect and amended as of the date of the supplier's proposal, and any subsections thereof as applicable, shall govern the design and selection of equipment and material supplied.

- A. NFPA 70 - National Electrical Code (NEC)
- B. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers (Handbooks)
- C. ANSI/ASHRAE Standard 135 (1995) – BACnet: A Data Communication Protocol for Building Automation and Control Networks
- D. UL 916 - Standard for Energy Management Equipment
- E. FCC – Part 15, Subpart J
- F. City, County, State and Federal regulations and codes in effect as of the date of the Contract



**1.04 DEFINITIONS**

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.
- B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
- C. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.
- D. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.
- E. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.
- F. COV: Changes of value.
- G. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.
- H. Distributed Control: Processing of system data is decentralized, and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.
- I. DOCSIS: Data-Over Cable Service Interface Specifications.
- J. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
- K. HLC: Heavy load conditions.
- L. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.
- M. LAN: Local area network.
- N. LNS: LonWorks Network Services.
- O. LON Specific Definitions:
  - 1. FTT-10: Echelon Transmitter-Free Topology Transceiver.
  - 2. LonMark: Association comprising suppliers and installers of LonTalk products. Association provides guidelines for implementing LonTalk protocol to ensure interoperability through a standard or consistent implementation.
  - 3. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication. LonTalk is a register trademark of Echelon.

4. LonWorks: Network technology developed by Echelon.
  5. Node: Device that communicates using CEA-709.1-C protocol and that is connected to a CEA-709.1-C network.
  6. Node Address: The logical address of a node on the network, consisting of a Domain number, Subnet number, and Node number. "Node number" portion of an address is a number assigned to device during installation, is unique within a subnet, and is not a factory-set unique Node ID.
  7. Node ID: A unique 48-bit identifier assigned at factory to each CEA-709.1-C device. Sometimes called a "Neuron ID."
  8. Program ID: An identifier (number) stored in a device (usually EEPROM) that identifies node manufacturer, functionality of device (application and sequence), transceiver used, and intended device usage.
  9. Standard Configuration Property Type (SCPT): Pronounced "skip-it." A standard format type maintained by LonMark International for configuration properties.
  10. Standard Network Variable Type (SNVT): Pronounced "snivet." A standard format type maintained by LonMark used to define data information transmitted and received by individual nodes. "SNVT" is used in two ways. It is an acronym for "Standard Network Variable Type" and is often used to indicate a network variable itself (i.e., it can mean "a network variable of a standard network variable type").
  11. Subnet: Consists of a logical grouping of up to 127 nodes, where logical grouping is defined by node addressing. Each subnet is assigned a number, which is unique within a Domain. See "Node Address."
  12. TP/FT-10: Free Topology Twisted Pair network defined by CEA-709.3 and is most common media type for a CEA-709.1-C control network.
  13. TP/XF-1250: High-speed, 1.25-Mbps, twisted-pair, doubly terminated bus network defined by "LonMark Interoperability Guidelines" typically used only to connect multiple TP/FT-10 networks.
  14. User-Defined Configuration Property Type (UCPT): Pronounced "U-Keep-It." A Configuration Property format type that is defined by device manufacturer.
  15. User-Defined Network Variable Type (UNVT): Network variable format defined by device manufacturer. UNVTs create non-standard communications that other vendors' devices may not correctly interpret and may negatively impact system operation. UNVTs are not allowed.
- P. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- Q. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.
- R. Modbus TCP/IP: An open protocol for exchange of process data.
- S. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- T. MTBF: Mean time between failures.
- U. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.
- V. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
- W. Peer to Peer: Networking architecture that treats all network stations as equal partners.

- X. POT: Portable operator's terminal.
- Y. PUE: Performance usage effectiveness.
- Z. RAM: Random access memory.
- AA. RF: Radio frequency.
- BB. Router: Device connecting two or more networks at network layer.
- CC. Server: Computer used to maintain system configuration, historical and programming database.
- DD. TCP/IP: Transport control protocol/Internet protocol.
- EE. UPS: Uninterruptible power supply.
- FF. USB: Universal Serial Bus.
- GG. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.
- HH. VAV: Variable air volume.
- II. WLED: White light emitting diode.

#### **1.05 ACTION SUBMITTALS**

- A. Multiple Submissions:
  - 1. If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission.
  - 2. Clearly identify each submittal requirement indicated and in which submission the information will be provided.
  - 3. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.
- B. Product Data: For each type of product include the following:
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 3. Product description with complete technical data, performance curves, and product specification sheets.
  - 4. Installation, operation and maintenance instructions including factors effecting performance.
  - 5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
    - a. Workstations.
    - b. Servers.
    - c. Printers.
    - d. Gateways.

- e. Routers.
  - f. Protocol analyzers.
  - g. DDC controllers.
  - h. Enclosures.
  - i. Electrical power devices.
  - j. UPS units.
  - k. Accessories.
  - l. Instruments.
  - m. Control dampers and actuators.
6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
  7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.
- C. Software Submittal:
1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
  2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
  3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
  4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
  5. Listing and description of each engineering equation used with reference source.
  6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
  7. Description of operator interface to alphanumeric and graphic programming.
  8. Description of each network communication protocol.
  9. Description of system database, including all data included in database, database capacity and limitations to expand database.
  10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
  11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- D. Shop Drawings:
1. General Requirements:
    - a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
    - b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
  2. Include plans, elevations, sections, and mounting details where applicable.
  3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  4. Detail means of vibration isolation and show attachments to rotating equipment.
  5. Plan Drawings indicating the following:
    - a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
    - b. Room names and numbers with coordinated placement to avoid interference with control products indicated.

- c. Each desktop workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
  - d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
  - e. Network communication cable and raceway routing.
  - f. Proposed routing of wiring, cabling, and conduit, coordinated with building services for review before installation.
6. Schematic drawings for each controlled HVAC system indicating the following:
    - a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
    - b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
    - c. A graphic showing location of control I/O in proper relationship to HVAC system.
    - d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
    - e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
    - f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
    - g. Narrative sequence of operation.
    - h. Graphic sequence of operation, showing all inputs and output logical blocks.
  7. Control panel drawings indicating the following:
    - a. Panel dimensions, materials, size, and location of field cable, and raceways.
    - b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
    - c. Front, rear, and side elevations and nameplate legend.
    - d. Unique drawing for each panel.
  8. DDC system network riser diagram indicating the following:
    - a. Each device connected to network with unique identification for each.
    - b. Interconnection of each different network in DDC system.
    - c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.
    - d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.
  9. DDC system electrical power riser diagram indicating the following:
    - a. Each point of connection to field power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
    - b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
    - c. Each product requiring power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
    - d. Power wiring type and size, race type, and size for each.
  10. Monitoring and control signal diagrams indicating the following:
    - a. Control signal cable and wiring between controllers and I/O.
    - b. Point-to-point schematic wiring diagrams for each product.
  11. Color graphics indicating the following:
    - a. Itemized list of color graphic displays to be provided.
    - b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
    - c. Intended operator access between related hierarchical display screens.

E. System Description:

1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
  2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
  3. System and product operation under each potential failure condition including, but not limited to, the following:
    - a. Loss of power.
    - b. Loss of network communication signal.
    - c. Loss of controller signals to inputs and outputs.
    - d. Operator workstation failure.
    - e. Server failure.
    - f. Gateway failure.
    - g. Network failure
    - h. Controller failure.
    - i. Instrument failure.
    - j. Control damper and valve actuator failure.
  4. Complete bibliography of documentation and media to be delivered to Owner.
  5. Description of testing plans and procedures.
  6. Description of Owner training.
- F. Delegated-Design Submittal: For DDC system products and installation indicated as being delegated.
1. Supporting documentation showing DDC system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
  2. Schedule and design calculations for control dampers and actuators.
    - a. Flow at Project design and minimum flow conditions.
    - b. Face velocity at Project design and minimum airflow conditions.
    - c. Pressure drop across damper at Project design and minimum airflow conditions.
    - d. AMCA 500-D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
    - e. Maximum close-off pressure.
    - f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
    - g. Torque required at worst case condition for sizing actuator.
    - h. Actuator selection indicating torque provided.
    - i. Actuator signal to control damper (on, close or modulate).
    - j. Actuator position on loss of power.
    - k. Actuator position on loss of control signal.
  3. Schedule and design calculations for control valves and actuators.
    - a. Flow at Project design and minimum flow conditions.
    - b. Pressure-differential drop across valve at Project design flow condition.
    - c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.
    - d. Design and minimum control valve coefficient with corresponding valve position.
    - e. Maximum close-off pressure.
    - f. Leakage flow at maximum system pressure differential.
    - g. Torque required at worst case condition for sizing actuator.
    - h. Actuator selection indicating torque provided.
    - i. Actuator signal to control damper (on, close or modulate).
    - j. Actuator position on loss of power.
    - k. Actuator position on loss of control signal.
  4. Schedule and design calculations for selecting flow instruments.
    - a. Instrument flow range.
    - b. Project design and minimum flow conditions with corresponding accuracy, control signal to transmitter and output signal for remote control.

- c. Extreme points of extended flow range with corresponding accuracy, control signal to transmitter and output signal for remote control.
- d. Pressure-differential loss across instrument at Project design flow conditions.
- e. Where flow sensors are mated with pressure transmitters, provide information for each instrument separately and as an operating pair.

## 1.06 INFORMATIONAL SUBMITTALS

### A. Coordination Drawings:

1. Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - a. Product installation location shown in relationship to room, duct, pipe and equipment.
  - b. Structural members to which products will be attached.
  - c. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices and other installed devices.
  - d. Size and location of wall access panels for products installed behind walls and requiring access.
2. Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - a. Ceiling components.
  - b. Size and location of access panels for products installed above inaccessible ceiling assemblies and requiring access.
  - c. Items penetrating finished ceiling including the following:
    - 1) Lighting fixtures.
    - 2) Air outlets and inlets.
    - 3) Speakers.
    - 4) Sprinklers.
    - 5) Access panels.
    - 6) Motion sensors.
    - 7) Pressure sensors.
    - 8) Temperature sensors and other DDC control system instruments.

### B. Qualification Data:

1. Systems Provider Qualification Data:
  - a. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.
  - b. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
  - c. Names of staff assigned to past project that will also be assigned to execute work of this Project.
  - d. Owner contact information for past project including name, phone number, and e-mail address.
  - e. Contractor contact information for past project including name, phone number, and e-mail address.
  - f. Architect contact information for past project including name, phone number, and e-mail address.
2. Manufacturer's qualification data.
3. Testing agency's qualifications data.

### C. Product Certificates:

1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with LonWorks.

- D. Product Test Reports: For each product that requires testing to be performed by [manufacturer] [manufacturer and witnessed by a qualified testing agency] [a qualified testing agency].
- E. Preconstruction Test Reports: For each separate test performed.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Sample Warranty: For manufacturer's warranty.

#### **1.07 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
    - b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
    - c. As-built versions of submittal Product Data.
    - d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
    - e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
    - f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
    - g. Engineering, installation, and maintenance manuals that explain how to:
      - 1) Design and install new points, panels, and other hardware.
      - 2) Perform preventive maintenance and calibration.
      - 3) Debug hardware problems.
      - 4) Repair or replace hardware.
    - h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
    - i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
    - j. List of recommended spare parts with part numbers and suppliers.
    - k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
    - l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
    - m. Licenses, guarantees, and warranty documents.
    - n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
    - o. Owner training materials.

#### **1.08 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.



- B. Include product manufacturers' recommended parts lists for proper product operation over four year period following warranty period. Parts list shall be indicated for each year.
- C. Furnish parts, as indicated by manufacturer's recommended parts list, for product operation during one year period following warranty period.
- D. Furnish quantity indicated of matching product(s) in Project inventory for each unique size and type of following:
  - 1. Network Controller: One
  - 2. Programmable Application Controller: One
  - 3. Application-Specific Controller: One
  - 4. Room Carbon Dioxide Sensor and Transmitter: One
  - 5. Room Moisture Sensor and Transmitter: One
  - 6. Room Pressure Sensor and Transmitter: One
  - 7. Room Temperature Sensor and Transmitter: One
  - 8. General-Purpose Relay: One
  - 9. Multifunction Time-Delay Relay: One
  - 10. Latching Relay: One
  - 11. Current-Sensing Relay: One
  - 12. Combination On-Off Status Sensor and On-Off Relay: One
  - 13. Transformer: One
  - 14. DC Power Supply: One
  - 15. Supply of 20 percent spare optical fiber cable splice organizer cabinets for several re-terminations.

#### 1.09 QUALITY ASSURANCE

- A. DDC System Manufacturer Qualifications:
  - 1. Nationally recognized manufacturer of DDC systems and products.
  - 2. DDC systems with similar requirements to those indicated for a continuous period of **10** years within time of bid.
  - 3. DDC systems and products that have been successfully tested and in use on at least **five** past projects.
  - 4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
  - 5. Having full-time in-house employees for the following:
    - a. Product research and development.
    - b. Product and application engineering.
    - c. Product manufacturing, testing and quality control.
    - d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
    - e. Owner operator training.
- B. DDC System Provider Qualifications:
  - 1. Authorized representative of, and trained by, DDC system manufacturer.
  - 2. Demonstrated past experience with installation of DDC system products being installed for period within five consecutive years before time of bid.
  - 3. Demonstrated past experience on five projects of similar complexity, scope and value.
  - 4. Each person assigned to Project shall have demonstrated past experience.
  - 5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
  - 6. Service and maintenance staff assigned to support Project during warranty period.
  - 7. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.

8. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.
- C. Testing Agency Qualifications: Member company of NETA.
  1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
  4. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."
- E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- F. Tools and Testing Equipment: The controls supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the control system.

## **1.10 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.
  1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
  2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
    - a. Install updates only after receiving Owner's written authorization.
  3. Warranty service shall occur during normal business hours and commence within 16 hours of Owner's warranty service request.
  4. Warranty Period: Two year(s) from date of Substantial Completion.
    - a. For Gateway: Three year parts and labor warranty for each.

## **PART 2 - PRODUCTS**

### **2.01 DDC SYSTEM MANUFACTURERS**

- A. The DDC control system shall be Tridium. The owner desires that the proposed system will interface seamlessly with future building systems. All proposed systems shall be programmable using Tridium software package and shall be monitored, scheduled, and alarmed via the a new graphical user interface. No separate computers, software links, or gateways are acceptable.
- B. Installation of the system shall be by qualified employees of the temperature control system manufacturer or its exclusive authorized representative and qualified subcontractor. Indirect temperature control work by non-qualified installing contractors performing work without direct supervision from the authorized representative will not be accepted.
- C. The installing contractor shall provide all tools, testing and calibration equipment necessary to ensure reliability and accuracy of the control system.

### **2.02 DDC SYSTEM DESCRIPTION**

- A. The Integration Platform shall include, but not be limited to, the following components/sub systems to provide a fully functional platform required for integrating the systems shown on the mechanical plans:

1. Niagara Web Supervisor
  2. Niagara Workbench
  3. Associated Niagara drivers and applications
  4. Niagara based hardware platforms (JACE)
  5. Installation, engineering, programming. commissioning
- B. The intent of this specification is to provide a BMS system that is consistent with BMS systems planned to be installed throughout the owner's facilities running on the Niagara 4 Framework.
- C. The installing contractor shall furnish all labor, materials and equipment necessary for a complete and operating Integration Platform, utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over an open protocol bus (Examples: LonTalk, BACnet, MODBUS). The installing contractor shall submit a Data Plan that includes database standards, graphics, dashboards, data tagging and program guidelines for the Engineer's review.
- D. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
- E. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any designated computer on the owner's LAN.
- F. All control devices furnished with the mechanical systems shall be programmable directly from the Niagara 4 Workbench embedded toolset for this project. The use of configurable or programmable controllers that require additional software tools or tools that require a specific Niagara 4 license brand to operate for post-installation maintenance shall not be acceptable.
- G. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
- H. The integration platform server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the Niagara 4 Framework server.
- I. A laptop computer shall be provided to the owner with the engineering/programming software (Niagara 4 Workbench).
- J. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
- K. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### **2.03 WEB ACCESS**

- A. DDC system shall be Web based or Web compatible.
1. Web-Based Access to DDC System:
    - a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed

- using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet.
  - b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
  - c. Web access shall be password protected.
- 2. Web-Compatible Access to DDC System:
  - a. Workstation shall perform overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation.
  - b. DDC system shall support Web browser access to building data. Operator using a standard Web browser shall be able to access control graphics and change adjustable set points.
  - c. Web access shall be password protected.

## 2.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design DDC system to satisfy requirements indicated.
- B. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.
  - 1. System Performance Objectives:
    - a. DDC system shall manage HVAC systems.
    - b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
    - c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
    - d. DDC system shall operate while unattended by an operator and through operator interaction.
    - e. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.
- C. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- D. DDC System Speed:
  - 1. Response Time of Connected I/O:
    - a. AI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
    - b. BI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
    - c. AO points connected to DDC system shall begin to respond to controller output commands within two second(s). Global commands shall also comply with this requirement.
    - d. BO point values connected to DDC system shall respond to controller output commands within two second(s). Global commands shall also comply with this requirement.
  - 2. Display of Connected I/O:
    - a. Analog point COV connected to DDC system shall be updated and displayed at least every 10 seconds for use by operator.

- b. Binary point COV connected to DDC system shall be updated and displayed at least 10 seconds for use by operator.
  - c. Alarms of analog and digital points connected to DDC system shall be displayed within 45 seconds of activation or change of state.
  - d. Graphic display refresh shall update within eight seconds.
  - e. Point change of values and alarms displayed from workstation to workstation when multiple operators are viewing from multiple workstations shall not exceed graphic refresh rate indicated.
- E. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.
- F. DDC System Data Storage:
  - 1. Include capability to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
  - 2. Local Storage:
    - a. Provide workstation with data storage indicated. Server(s) shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.
  - 3. Cloud Storage:
    - a. Provide application-based and web browser interfaces to configure, upload, download, and manage data, and service plan with storage adequate to store all data for term indicated. Cloud storage shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.
- G. DDC Data Access:
  - 1. When logged into the system, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
  - 2. System(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.
- H. Future Expandability:
  - 1. DDC system size shall be expandable to an ultimate capacity of at least four times total I/O points indicated.
  - 2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
  - 3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.
- I. Input Point Displayed Accuracy: Input point displayed values shall meet following end-to-end overall system accuracy, including errors associated with meter, sensor, transmitter, lead wire or cable, and analog to digital conversion.
  - 1. Energy:
    - a. Thermal: Within 5 percent of reading.
    - b. Electric Power: Within 1percent of reading.
    - c. Requirements indicated on Drawings for meters not supplied by utility.
  - 2. Temperature, Dew Point:
    - a. Air: Within 1 deg F
    - b. Space: Within 1 deg F
    - c. Outdoor: Within 2 deg F

3. Temperature, Dry Bulb:
  - a. Air: Within 1 deg F
  - b. Space: Within 1 deg F
  - c. Outdoor: Within 1 deg F
  
- J. Precision of I/O Reported Values: Values reported in database and displayed shall have following precision:
  1. Current:
    - a. Milliamperes: Nearest 1/100th of a milliampere.
    - b. Amperes: Nearest 1/10th of an ampere up to 100 A; nearest ampere for 100 A and more.
  2. Energy:
    - a. Electric Power:
      - 1) Rate (Watts): Nearest 1/10th of a watt through 1000 W.
      - 2) Rate (Kilowatts): Nearest 1/10th of a kilowatt through 1000 kW; nearest kilowatt above 1000 kW.
      - 3) Usage (Kilowatt-Hours): Nearest kilowatt through 10,000 kW; nearest 10 kW between 10,000 and 100,000 kW; nearest 100 kW for above 100,000 kW.
  3. Position, Dampers and Valves (Percentage Open): Nearest 1 percent.
  4. Temperature, Dew Point:
    - a. Air: Within 1 deg F
    - b. Space: Within 1 deg F
  5. Temperature, Dry Bulb:
    - a. Air: Within 1 deg F
    - b. Space: Within 1 deg F
  6. Temperature, Wet Bulb:
    - a. Air: Within 1 deg F
    - b. Space: Within 1 deg F
  
- K. Environmental Conditions for Controllers, Gateways, and Routers:
  1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.
    - a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.
  2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
    - a. Outdoors, Protected: Type 3
    - b. Outdoors, Unprotected: Type 4X
    - c. Indoors, Heated with Filtered Ventilation: Type 1
    - d. Indoors, Heated with Non-Filtered Ventilation: Type 2
    - e. Indoors, Heated and Air Conditioned: Type 1
    - f. Mechanical Equipment Rooms:
      - 1) Air-Moving Equipment Rooms: Type 2
    - g. Localized Areas Exposed to Washdown: Type 4X
    - h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2
    - i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4
  
- L. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
    - a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.
  2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
    - a. Outdoors, Protected: Type 3
    - b. Outdoors, Unprotected: Type 4X
    - c. Indoors, Heated with Filtered Ventilation: Type 1
    - d. Indoors, Heated with Non-Filtered Ventilation: Type 2
    - e. Indoors, Heated and Air Conditioned: Type 1
    - f. Mechanical Equipment Rooms:
      - 1) Air-Moving Equipment Rooms: Type 2
    - g. Localized Areas Exposed to Washdown: Type 4X
    - h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2
    - i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4
- M. DDC System Reliability:
1. Design, install and configure DDC controllers, gateways, and routers to yield a MTBF of at least 40,000 hours, based on a confidence level of at least 90percent. MTBF value shall include any failure for any reason to any part of products indicated.
  2. If required to comply with MTBF indicated, include DDC system and product redundancy to maintain DCC system, and associated systems and equipment that are being controlled, operational and under automatic control.
  3. Critical systems and equipment that require a higher degree of DDC system redundancy than MTBF indicated shall be indicated on Drawings.
- N. Electric Power Quality:
1. Power-Line Surges:
    - a. Protect DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
    - b. Do not use fuses for surge protection.
    - c. Test protection in the normal mode and in the common mode, using the following two waveforms:
      - 1) 10-by-1000-mic.sec. waveform with a peak voltage of 1500 V and a peak current of 60 A.
      - 2) 8-by-20-mic.sec. waveform with a peak voltage of 1000 V and a peak current of 500 A.
  2. Power Conditioning:
    - a. Protect DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:
      - 1) At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
      - 2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
      - 3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.

- 4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.
3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.
- O. Backup Power Source:
  1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.
- P. UPS:
  1. DDC system products powered by UPS units shall include the following:
    - a. Desktop workstations.
    - b. Printers.
    - c. Servers.
    - d. Gateways.
    - e. DDC controllers
- Q. Continuity of Operation after Electric Power Interruption:
  1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

## **2.05 PANEL-MOUNTED, MANUAL OVERRIDE SWITCHES**

- A. Manual Override of Control Dampers:
  1. Include panel-mounted, two-position, selector switch for each automatic control damper being controlled by DDC controller.
  2. Label each switch with damper designation served by switch.
  3. Label switch positions to indicate either "Manual" or "Auto" control signal to damper.
  4. With switch in "Auto" position signal to control damper actuator shall be control loop output signal from DDC controller.
  5. With switch in "Manual" position, signal to damper actuator shall be controlled at panel with either an integral or separate switch to include local control.
    - a. For Binary Control Dampers: Manual two-position switch shall have "Close" and "Open" switch positions indicated. With switch in "Close" position, damper shall close. With switch in "Open" position, damper shall open.
    - b. For Analog Control Dampers: A gradual switch shall have "Close" and "Open" switch limits indicated. Operator shall be able to rotate switch knob to adjust damper to any position from close to open.
  6. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that damper is under manual, not automatic, control.
  7. Configure manual override switches to allow operator to manually operate damper while at panel without DDC controller installed.
  8. Terminal equipment including fan-coil units do not require manual override unless otherwise indicated by sequence of operation.

## **2.06 SYSTEM ARCHITECTURE**

- A. System architecture shall consist of no more than two levels of LANs.
  1. Level one LAN shall connect network controllers and operator workstations.
  2. Level one Level two LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.



- B. DDC system shall consist of dedicated LANs that are not shared with other building systems and tenant data and communication networks.
- C. System architecture shall be modular and have inherent ability to expand to not less than three times system size indicated with no impact to performance indicated.
- D. System architecture shall perform modifications without having to remove and replace existing network equipment.
- E. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.
- F. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.
- G. Special Network Architecture Requirements:
  - 1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s). Basically, create a DDC system LAN that aligns with air-handling system being controlled.

## **2.07 DDC SYSTEM OPERATOR INTERFACES**

- A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:
  - 1. Desktop and portable workstation with hardwired connection through LAN port.
  - 2. Portable operator terminal with hardwired connection through LAN port.
  - 3. Portable operator workstation with wireless connection through LAN router.
  - 4. Mobile device and application with secured wireless connection through LAN router or cellular data service.
  - 5. Remote connection through web access.
- B. Access to system, regardless of operator means used, shall be transparent to operator.
- C. Network Ports: For hardwired connection of desktop or portable workstation. Network port shall be easily accessible, properly protected, clearly labeled, and installed at the following locations:
  - 1. Each mechanical equipment room.
  - 2. Each different roof level with roof-mounted air-handling units or rooftop units.
  - 3. Security system command center.
  - 4. Fire-alarm system command center.
- D. Desktop Workstations:
  - 1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
  - 2. Able to communicate with any device located on any DDC system LAN.
- E. POT:
  - 1. Connect DDC controller through a communications port local to controller.
  - 2. Able to communicate with any DDC system controller that is directly connected.
- F. Critical Alarm Reporting:
  - 1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.

2. DDC system shall send alarm notification to multiple recipients that are assigned for each alarm.
  3. DDC system shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.
- G. Simultaneous Operator Use: Capable of accommodating up to five simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

## 2.08 NETWORKS

- A. Acceptable networks for connecting workstations, mobile devices, and network controllers include the following:
1. ATA 878.1, ARCNET.
  2. CEA-709.1-C.
  3. IP.
  4. IEEE 8802-3, Ethernet.
- B. Acceptable networks for connecting programmable application controllers include the following:
1. ATA 878.1, ARCNET.
  2. CEA-709.1-C.
  3. IP.
  4. IEEE 8802-3, Ethernet.
- C. Acceptable networks for connecting application-specific controllers include the following:
1. ATA 878.1, ARCNET.
  2. CEA-709.1-C.
  3. EIA-485A.
  4. IP.
  5. IEEE 8802-3, Ethernet.

## 2.09 NETWORK COMMUNICATION PROTOCOL

- A. Network communication protocol(s) used throughout entire DDC system shall be open to Owner and available to other companies for use in making future modifications to DDC system.
- B. ASHRAE 135 Protocol:
1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
  2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
  3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
- C. CEA-709.1-C Protocol:
1. DDC system shall be an open implementation of LonWorks technology using CEA 709.1-C communication protocol and using LonMark SNVTs as defined in LonMark SNVT list exclusively for communication throughout DDC system.
  2. LNS shall be used for all network management including addressing and binding of network variables.
    - a. Final LNS database shall be submitted with Project closeout submittals.
    - b. All devices shall be online and commissioned into LNS database.

3. All devices connected to DDC system network(s) shall use CEA-709.1-C protocol and be installed so SCPT output from any node on network can be bound to any other node in the domain.
- D. Industry Standard Protocols:
1. DDC system shall use any one or a combination of the following industry standard protocols for network communication while complying with other DDC system requirements indicated:
    - a. ASHRAE 135.
    - b. CEA-709.1-C.
    - c. Modbus Application Protocol Specification V1.1b.
  2. Operator workstations CEA-709.1-C protocol.
  3. Portions of DDC system networks using ASHRAE 135 communication protocol shall be an open implementation of network devices complying with ASHRAE 135. Network devices shall be tested and listed by BACnet Testing Laboratories.
  4. Portions of DDC system networks using CEA-709.1-C communication protocol shall be an open implementation of LonWorks technology using CEA-709.1-C communication protocol and using LonMark SNVTs as defined in LonMark SNVT list exclusively for DDC system.
  5. Portions of DDC system networks using Modbus Application Protocol Specification V1.1b communication protocol shall be an open implementation of network devices and technology complying with Modbus Application Protocol Specification V1.1b.
  6. Gateways shall be used to connect networks and network devices using different protocols.

## **2.10 DDC SYSTEM WIRELESS NETWORKS**

- A. Use an open industry standard and technology used by multiple DDC system manufacturers technology to create a wireless mesh network to provide wireless connectivity for network devices at multiple system levels including communications from programmable application controllers and application-specific controllers to temperature sensors and from network controllers to programmable application controllers and application-specific controllers.
- B. Installer shall design wireless networks to comply with DDC system performance requirements indicated. Wireless network devices shall co-exist on same network with hardwired devices.
- C. Hardwired controllers shall be capable of retrofit to wireless devices with no special software.
- D. A wireless coordinator shall provide a wireless interface between programmable application controllers, application-specific controllers, and network controllers.
- E. Wireless Coordinators:
1. Each wireless mesh network shall use wireless coordinator(s) for initiation and formation of network.
  2. Use direct sequence spread spectrum RF technology.
  3. Operate on the 2.4-GHz ISM Band.
  4. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
  5. FCC compliant to 47 CFR 15, Subpart B, Class A.
  6. Operate as a bidirectional transceiver with sensors and routers to confirm and synchronize data transmission.
  7. Capable of communication with sensors and routers up to a maximum distance of 250 feet in line of sight.
  8. Include visual indicators to provide diagnostic information required for operator verification of operation.
- F. Wireless Routers:

1. Each wireless mesh network shall use wireless routers with any controller to provide a wireless interface to a network controller, through a wireless coordinator.
  2. Use direct sequence spread spectrum RF technology.
  3. Operate on the 2.4-GHz ISM Band.
  4. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
  5. FCC compliant to 47 CFR 15, Subpart B, Class A.
  6. Operate as a bidirectional transceiver with other mesh network devices to ensure network integrity.
  7. Capable of communication with other mesh network devices at a maximum distance of 250 feet in line of sight.
  8. Include indication for use in commissioning and troubleshooting.
- G. Wireless Temperature Sensors:
1. Wireless temperature sensors shall sense and transmit room temperatures, temperature set point, room occupancy notification and low battery condition to an associated router.
  2. Use direct sequence spread spectrum RF technology.
  3. Operate on the 2.4-GHz ISM Band.
  4. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
  5. FCC compliant to CFR 15, Subpart B, Class A.
  6. Include set point adjustment between 55 to 85 deg F
  7. Multiple sensors shall be able to report to a router connected to a DDC controller for averaging or high and low selection.
- H. One-to-One Wireless Network Receivers:
1. One-to-one wireless receivers shall receive wireless RF signals containing temperature data from multiple wireless room temperature sensors and communicate information to programmable application controllers or application-specific controllers.
    - a. Use direct sequence spread spectrum RF technology.
    - b. Operate on the 2.4-GHz ISM Band.
    - c. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
    - d. FCC compliant to 47 CFR 15, Subpart B, Class A.
    - e. Operate as a bidirectional transceiver with the sensors to confirm and synchronize data transmission.
    - f. Capable of communication up to a distance of 200 feet
    - g. Include visual indication of the following:
      - 1) Power.
      - 2) Receiver activity.
      - 3) Wireless RF transmission from wireless sensors.
      - 4) No transmission, weak signal, adequate signal or excellent signal.
- I. One-to-One Wireless Network Sensors:
1. One-to-one wireless sensors shall sense and report room temperatures to one-to-one receiver.
    - a. Use direct sequence spread spectrum RF technology.
    - b. Operate on the 2.4-GHz ISM Band.
    - c. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
    - d. FCC compliant to CFR 15, Subpart B, Class A.
    - e. Include set point adjustment between 55 to 85 deg F

## 2.11 DESKTOP WORKSTATIONS

- A. Description: A tower or all-in-one computer designed for normal use at a single, semipermanent location.
- B. Performance Requirements:

1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
  2. Energy Star compliant.
- C. Personal Computer:
1. Minimum Processor Speed:
  2. RAM:
    - a. Capacity: 8GB.
  3. Sound Card:
    - a. At least 128 voice wavetable synthesis.
    - b. Capable of delivering three-dimensional sound effects.
    - c. High-resolution 16-bit stereo digital audio recording and playback with user-selectable sample rates up to 48,000 Hz.
  4. Network Interface Card: Include card with connection, as applicable.
    - a. 10-100-1000 base TX Ethernet with RJ45 connector port.
    - b. 100 base FX Ethernet with SC or ST port.
- D. Wireless Ethernet, 802.11 a/b/g/n.
1. Optical Modem: Full duplex link for connection to optical fiber cable provided.
  2. I/O Ports:
    - a. Two USB 3.0 ports on front panel, six on back panel, and three internal on motherboard.
    - b. One serial port.
    - c. One parallel port.
    - d. Two PS/2 ports.
    - e. One RJ-45.
    - f. One stereo line-in and headphone/line-out on back panel.
    - g. One microphone and headphone connector on front panel.
    - h. One IEEE 1394 on front and back panel with PCI-e card.
    - i. One ESATA port on back panel.
  3. Battery: Life of at least three years to maintain system clock/calendar and ROM, as a minimum.
- E. Keyboard:
1. 101 enhanced keyboard.
  2. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.
  3. Wireless operation within up to 72 inches (1800 mm) in front of workstation.
- F. Pointing Device:
1. Either a two- or three-button mouse.
  2. Wireless operation within up to 72 inches (1800 mm) in front of workstation.
- G. Flat Panel Display Monitor:
1. Display:
    - a. Color display with 17 inch diagonal viewable area.
- H. Speakers:
1. Two, with individual controls for volume, bass and treble.
  2. Signal to Noise Ratio: At least 65 dB.
  3. Power: At least 4 W per speaker/channel.
  4. Magnetic shielding to prevent distortion on the video monitor.
- I. I/O Cabling: Include applicable cabling to connect I/O devices.

**2.12 PORTABLE WORKSTATIONS**

- A. Description: A self-contained computer designed to allow for normal use in different locations and conditions.
- B. Performance Requirements:
  - 1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
  - 2. Energy Star compliant.
  - 3. Hardware and software shall support local down-loading to DDC controllers.
  - 4. Data transfer rate to DDC controller shall be at network speed.
- C. Processor:
  - 1. Minimum Processor Speed:
  - 2. RAM:
    - a. Capacity: 8 GB
- D. Input and Output Ports:
  - 1. Serial port.
  - 2. Shared port for external keyboard or mouse.
  - 3. Four USB 3.0 ports.
  - 4. Ethernet port.
  - 5. HDMI port.
  - 6. IEEE 1394 port.
- E. Battery:
  - 1. Capable of supporting operation of portable workstation for a minimum of 8 hours.
  - 2. Battery life of at least three years.
  - 3. Battery charge time of less than three hours.
  - 4. Spare Batteries two.
- F. Integral Pointing Device: Touchpad with two buttons. Gesture enabled.
- G. Display:
  - 1. 15 inch diagonal or larger high-definition WLED color display.
  - 2. Antiglare screen.
  - 3. Brightness: 300 nits.
- H. Network Interfaces:
  - 1. Network Interface Card: Include card with connection, as application.
    - a. 10-100-1000 base TX Ethernet with RJ45 connector port.
    - b. 100 base FX Ethernet with SC or ST port.
  - 2. Wireless:
    - a. Internal with integrated antenna, capable of supporting 802.11 a/b/g/n.
- I. Digital Video Disc Rewrite Recorder (DVD+/-RW):
  - 1. Compatible with DVD disks and data, audio, recordable and rewritable compact disks.
  - 2. 160-ms access time.
- J. Accessories:
  - 1. Nylon carrying case.
  - 2. Docking station.
  - 3. Mobile broadband card.
  - 4. Wireless optical mouse.
  - 5. Light-sensitive web cam and noise-cancelling digital array microphone.

6. Category 6a patch cable. Minimum cable length shall be
7. HDMI cable. Minimum cable length shall be

### **2.13 PORTABLE OPERATOR TERMINAL**

- A. Description: Handheld device with integral keypad or touch screen operator interface.
- B. Display: Multiple lines of text display for use in operator interaction with DDC system.
- C. Cable: Flexible cable, at least 36 inches long, with a plug-in jack for connection to DDC controllers, network ports or instruments with an integral LAN port. As an alternative to hardwired connection, POT shall be accessible to DDC controllers through a wireless network connection.
- D. POT shall be powered through network connection.
- E. Connection of POT to DDC system shall not interrupt or interfere with normal network operation in any way, prevent alarms from being transmitted, or preclude central initiated commands and system modification.
- F. POT shall give operator the ability to do the following:
  1. Display and monitor BI point status.
  2. Change BO point set point (on or off, open or closed).
  3. Display and monitor analog point values.
  4. Change analog control set points.
  5. Command a setting of AO point.
  6. Display and monitor I/O point in alarm.
  7. Add a new or delete an existing I/O point.
  8. Enable and disable I/O points, initiators, and programs.
  9. Display and change time and date.
  10. Display and change time schedules.
  11. Display and change run-time counters and run-time limits.
  12. Display and change time and event initiation.
  13. Display and change control application and DDC parameters.
  14. Display and change programmable offset values.
  15. Access DDC controller initialization routines and diagnostics.
- G. Servers shall include the following:
  1. Full-feature backup server (server and backup minimum requirement).
  2. Software licenses.
  3. Cable installation between server(s) and network.
- H. Web Server:
  1. If required to be separate, include Web server hardware and software to match, except backup server is not required.
  2. Firewalls between server Web and networks.
  3. Password protection for access to server from Web server.
  4. Cable installation between the server(s) and building Ethernet network.

### **2.14 SYSTEM SOFTWARE**

- A. System Software Minimum Requirements:
  1. Real-time multitasking and multiuser 32 or 64 bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.

2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Operator sign-on and sign-off activity shall be recorded and sent to printer.
6. Security Access:
  - a. Operator access to DDC system shall be under password control.
  - b. An alphanumeric password shall be field assignable to each operator.
  - c. Operators shall be able to access DDC system by entry of proper password.
  - d. Operator password shall be same regardless of which computer or other interface means is used.
  - e. Additions or changes made to passwords shall be updated automatically.
  - f. Each operator shall be assigned an access level to restrict access to data and functions the operator is cable of performing.
  - g. Software shall have at least five access levels.
  - h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
  - i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.
7. Data Segregation:
  - a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.
  - b. Include at least 32 segregation groups.
  - c. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.
  - d. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
  - e. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.
  - f. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.
8. Operators shall be able to perform commands including, but not limited to, the following:



- a. Start or stop selected equipment.
  - b. Adjust set points.
  - c. Add, modify, and delete time programming.
  - d. Enable and disable process execution.
  - e. Lock and unlock alarm reporting for each point.
  - f. Enable and disable totalization for each point.
  - g. Enable and disable trending for each point.
  - h. Override control loop set points.
  - i. Enter temporary override schedules.
  - j. Define holiday schedules.
  - k. Change time and date.
  - l. Enter and modify analog alarm limits.
  - m. Enter and modify analog warning limits.
  - n. View limits.
  - o. Enable and disable demand limiting.
  - p. Enable and disable duty cycle.
  - q. Display logic programming for each control sequence.
9. Reporting:
- a. Generated automatically and manually.
  - b. Sent to displays, printers and disk files.
  - c. Types of Reporting:
    - 1) General listing of points.
    - 2) List points currently in alarm.
    - 3) List of off-line points.
    - 4) List points currently in override status.
    - 5) List of disabled points.
    - 6) List points currently locked out.
    - 7) List of items defined in a "Follow-Up" file.
    - 8) List weekly schedules.
    - 9) List holiday programming.
    - 10) List of limits and deadbands.
10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.
- C. Graphic Interface Software:
- 1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable (for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.
  - 2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.
  - 3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.
  - 4. Descriptors for graphics, points, alarms and such shall be modified through operator's workstation under password control.
  - 5. Graphic displays shall be online user definable and modifiable using the hardware and software provided.
  - 6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.
  - 7. Graphics are to be online programmable and under password control.
  - 8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.
  - 9. Graphics shall also contain software points.

10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.
11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing device. Back trace shall show all previous penetration levels. Include operator with option of showing each graphic full screen size with back trace as horizontal header or by showing a "stack" of graphics, each with a back trace.
12. Display operator accessed data on the monitor.
13. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.
14. Include operator with means to directly access graphics without going through penetration path.
15. Dynamic data shall be assignable to graphics.
16. Display points (physical and software) with dynamic data provided by DDC system with appropriate text descriptors, status or value, and engineering unit.
17. Use color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.
18. Points shall be dynamic with operator adjustable update rates on a per point basis from one second to over a minute.
19. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.
  - a. For an analog command point such as set point, current conditions and limits shall be displayed and operator can position new set point using pointing device.
  - b. For a digital command point such as valve position, valve shall show its current state such as open or closed and operator could select alternative position using pointing device.
  - c. Keyboard equivalent shall be available for those operators with that preference.
20. Operator shall be able to split or resize viewing screen into quadrants to show one graphic on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing, curve plot and other information on other quadrants on screen. This feature shall allow real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.
21. Help Features:
  - a. On-line context-sensitive help utility to facilitate operator training and understanding.
  - b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.
    - 1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed word-processing program, which shall run concurrently with operating system software.
  - c. Available for Every Menu Item:
    - 1) Index items for each system menu item.
22. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.
  - a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, and electrical symbols.
  - b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:
    - 1) Define background screens.
    - 2) Define connecting lines and curves.
    - 3) Locate, orient and size descriptive text.
    - 4) Define and display colors for all elements.
    - 5) Establish correlation between symbols or text and associated system points or other displays.

- D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:
1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.
  2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:
    - a. Room layouts with room identification and name.
    - b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.
    - c. Location and identification of each hardware point being controlled or monitored by DDC system.
  3. Control schematic for each of following, including a graphic system schematic representation, similar to that indicated on Drawings, with point identification, set point and dynamic value indication, sequence of operation.
  4. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.
  5. DDC system network riser diagram that shows schematic layout for entire system including all networks and all controllers, gateways, operator workstations and other network devices.
- E. Customizing Software:
1. Software to modify and tailor DDC system to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.
  2. Online modification of DDC system configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
  3. As a minimum, include the following modification capability:
    - a. Operator assignment shall include designation of operator passwords, access levels, point segregation and auto sign-off.
    - b. Peripheral assignment capability shall include assignment of segregation groups and operators to consoles and printers, designation of backup workstations and printers, designation of workstation header points and enabling and disabling of print-out of operator changes.
    - c. System configuration and diagnostic capability shall include communications and peripheral port assignments, DDC controller assignments to network, DDC controller enable and disable, assignment of command trace to points and application programs and initiation of diagnostics.
    - d. System text addition and change capability shall include English or native language descriptors for points, segregation groups and access levels and action messages for alarms, run time and trouble condition.
    - e. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedules.
    - f. Point related change capability shall include the following:
      - 1) System and point enable and disable.
      - 2) Run-time enable and disable.
      - 3) Assignment of points to segregation groups, calibration tables, lockout, and run time and to a fixed I/O value.
      - 4) Assignment of alarm and warning limits.
    - g. Application program change capability shall include the following:
      - 1) Enable and disable of software programs.
      - 2) Programming changes.
      - 3) Assignment of comfort limits, global points, time and event initiators, time and event schedules and enable and disable time and event programs.
  4. Software shall allow operator to add points, or groups of points, to DDC system and to link them to energy optimization and management programs. Additions and modifications shall be online programmable using operator workstation, downloaded to other network

- devices and entered into their databases. After verification of point additions and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.
5. Include high-level language programming software capability for implementation of custom DDC programs. Software shall include a compiler, linker, and up- and down-load capability.
  6. Include a library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences. Also include, as a minimum, the following:
    - a. Proportional control (P).
    - b. Proportional plus integral (PI).
    - c. Proportional plus integral plus derivative (PID).
    - d. Adaptive and intelligent self-learning control.
      - 1) Algorithm shall monitor loop response to output corrections and adjust loop response characteristics according to time constant changes imposed.
      - 2) Algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of system dynamics so that on system shut down and restart, learning process starts from where it left off.
  7. Fully implemented intrinsic control operators including sequence, reversing, ratio, time delay, time of day, highest select AO, lowest select AO, analog controlled digital output, analog control AO, and digitally controlled AO.
  8. Logic operators such as "And," "Or," "Not," and others that are part of a standard set available with a high-level language.
  9. Arithmetic operators such as "Add," "Subtract," "Multiply," "Divide," and others that are part of a standard set available with a high-level language.
  10. Relational operators such as "Equal To," "Not Equal To," "Less Than," "Greater Than," and others that are part of a standard set available with a high-level language.
- F. Alarm Handling Software:
1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers gateways and other network devices.
  2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
  3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
  4. Alarms display shall include the following:
    - a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
    - b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
    - c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
    - d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.
  5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
  6. Send e-mail alarm messages to designated operators.
  7. Send e-mail, page, text and voice messages to designated operators for critical alarms.
  8. Alarms shall be categorized and processed by class.
    - a. Class 1:
      - 1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.
      - 2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
      - 3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.

- b. Class 2:
    - 1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
    - 2) Acknowledgement may be through a multiple alarm acknowledgment.
  - c. Class 3:
    - 1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
    - 2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
    - 3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgment.
    - 4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.
  - d. Class 4:
    - 1) Routine maintenance or other types of warning alarms.
    - 2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.
9. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
10. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.
- G. Reports and Logs:
- 1. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
  - 2. Each report shall be definable as to data content, format, interval and date.
  - 3. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation or server for historical reporting.
  - 4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
  - 5. Reports and logs shall be stored on workstation hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
  - 6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.
- H. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.
- 1. All I/O: With current status and values.
  - 2. Alarm: All current alarms, except those in alarm lockout.
  - 3. Disabled I/O: All I/O points that are disabled.
  - 4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
  - 5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
  - 6. Logs:
    - a. Alarm history.
    - b. System messages.
    - c. System events.
    - d. Trends.
- I. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.
- J. Tenant Override Reports: Prepare Project-specific reports.

1. Weekly report showing daily total time in hours that each tenant has requested after-hours HVAC.
  2. Monthly report showing daily total time in hours that each tenant has requested after-hours HVAC.
  3. Annual summary report that shows after-hours HVAC usage on a monthly basis.
- K. HVAC Equipment Reports: Prepare Project-specific reports.
1. Chiller Report: Daily report showing operating conditions of each chiller according to ASHRAE 147, including, but not limited to, the following:
    - a. Evaporator refrigerant pressure and temperature.
    - b. Compressor refrigerant discharge temperature.
    - c. Compressor refrigerant suction temperature.
    - d. Ambient temperature (dry bulb and wet bulb).
    - e. Date and time logged.
- L. Weather Reports:
1. Include monthly report showing the following:
    - a. Daily minimum, maximum, and average outdoor dry-bulb temperature.
    - b. Daily minimum, maximum, and average outdoor wet-bulb temperature.
    - c. Daily minimum, maximum, and average outdoor dew point temperature.
    - d. Number of heating degree-days for each day calculated from a base temperature of 55 deg F .
    - e. Number of cooling degree-days for each day calculated from a base temperature of 65 deg F.
    - f. Daily minimum, maximum, and average outdoor carbon dioxide level.
    - g. Daily minimum, maximum, and average relative humidity.
    - h. Daily minimum, maximum, and average barometric pressure.
    - i. Daily minimum, maximum, and average wind speed and direction.
  2. Include annual (12-month) report showing the following:
    - a. Monthly minimum, maximum, and average outdoor dry-bulb temperature.
    - b. Monthly minimum, maximum, and average outdoor wet-bulb temperature.
    - c. Monthly minimum, maximum, and average outdoor dew point temperature.
    - d. Number of heating degree-days for each month calculated from a base temperature of 55 deg F
    - e. Number of cooling degree-days for each month calculated from a base temperature of 65 deg F
    - f. Annual minimum, maximum, and average outdoor carbon dioxide level.
    - g. Monthly minimum, maximum, and average relative humidity.
    - h. Daily minimum, maximum, and average barometric pressure.
    - i. Daily minimum, maximum, and average wind speed and direction.
- M. Standard Trends:
1. Trend all I/O point present values, set points, and other parameters indicated for trending.
  2. Trends shall be associated into groups, and a trend report shall be set up for each group.
  3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75 of DDC controller buffer limit, or by operator request, or by archiving time schedule.
  4. Preset trend intervals for each I/O point after review with Owner.
  5. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Minimum number of consecutive trend values stored at one time shall be 100 per variable.
  6. When drive storage memory is full, most recent data shall overwrite oldest data.
  7. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.
- N. Custom Trends: Operator shall be able to define a custom trend log for any I/O point in DDC system.

1. Each trend shall include interval, start time, and stop time.
  2. Data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation hard drives.
  3. Data shall be retrievable for use in spreadsheets and standard database programs.
- O. Programming Software:
1. Include programming software to execute sequences of operation indicated.
  2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
  3. Programming software shall be any of the following:
    - a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for DDC control systems.
      - 1) Function blocks shall be assembled with interconnection lines that represent to control sequence in a flowchart.
      - 2) Programming tools shall be viewable in real time to show present values and logical results of each function block.
    - b. Menu Based: Programming shall be done by entering parameters, definitions, conditions, requirements and constraints.
    - c. Line by Line and Text Based: Programming shall declare variable types such as local, global, real, integer, and so on, at the beginning of the program. Use descriptive comments frequently to describe programming code.
  4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.
- P. Database Management Software:
1. Where a separate SQL database is used for information storage, DDC system shall include database management software that separates database monitoring and managing functions by supporting multiple separate windows.
  2. Database secure access shall be accomplished using standard SQL authentication including ability to access data for use outside of DDC system applications.
  3. Database management function shall include summarized information on trend, alarm, event, and audit for the following database management actions:
    - a. Backup.
    - b. Purge.
    - c. Restore.
  4. Database management software shall support the following:
    - a. Statistics: Display database server information and trend, alarm, event, and audit information on database.
    - b. Maintenance: Include method of purging records from trend, alarm, event and audit databases by supporting separate screens for creating a backup before purging, selecting database, and allowing for retention of a selected number of day's data.
    - c. Backup: Include means to create a database backup file and select a storage location.
    - d. Restore: Include a restricted means of restoring a database by requiring operator to have proper security level.
  5. Database management software shall include information of current database activity, including the following:
    - a. Ready.
    - b. Purging record from a database.
    - c. Action failed.
    - d. Refreshing statistics.
    - e. Restoring database.
    - f. Shrinking a database.

- g. Backing up a database.
  - h. Resetting Internet information services.
  - i. Starting network device manager.
  - j. Shutting down the network device manager.
  - k. Action successful.
6. Database management software monitoring functions shall continuously read database information once operator has logged on.
  7. Include operator notification through on-screen pop-up display and e-mail message when database value has exceeded a warning or alarm limit.
  8. Monitoring settings window shall have the following sections:
    - a. Allow operator to set and review scan intervals and start times.
    - b. E-mail: Allow operator to create and review e-mail and phone text messages to be delivered when a warning or an alarm is generated.
    - c. Warning: Allow operator to define warning limit parameters, set reminder frequency and link e-mail message.
    - d. Alarm: Allow operator to define alarm limit parameters, set reminder frequency and link e-mail message.
    - e. Database Login: Protect system from unauthorized database manipulation by creating a read access and a write access for each of trend, alarm, event and audit databases as well as operator proper security access to restore a database.
  9. Monitoring settings taskbar shall include the following informational icons:
    - a. Normal: Indicates by color and size, or other easily identifiable means that all databases are within their limits.
    - b. Warning: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their warning limit.
    - c. Alarm: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their alarm limit.

## **2.15 OFFICE APPLICATION SOFTWARE**

- A. Include current version of office application software at time of Substantial Completion.
- B. Office application software package shall include multiple separate applications and use a common platform for all applications, similar to Microsoft's "Office Professional."
  1. Database.
  2. E-mail.
  3. Presentation.
  4. Publisher.
  5. Spreadsheet.
  6. Word processing.

## **2.16 MAINTENANCE MANAGEMENT SOFTWARE**

- A. Scope:
  1. Include complete and functional software-driven maintenance management system. Software shall perform scheduling of preventive maintenance and generation of work orders, for mechanical and electrical equipment and systems.
  2. Work orders shall be automatically generated from alarm conditions, run time, and calendar time. Each work order generated shall list parts, tools, craftspeople, and define task to be performed.
  3. Work order generated shall be used to schedule a repair or preventive maintenance routine.
  4. Work order shall be used to track completion of work, parts used and total cost of repair.
  5. A database shall include an inventory tracking system. Work orders generated shall automatically update inventory database to show quantity of tools, repair parts and expendables used for a work order.



6. Work orders and preventive maintenance schedules shall be printed on a dedicated printer assigned solely to maintenance management function.
- B. Additional Hardware Requirements:
1. Maintenance management software shall not require additional hardware, except for an additional printer that is dedicated to maintenance management.
  2. Maintenance management software shall be integrated into DDC system.
- C. Software Requirements:
1. From main menu of maintenance management system, it shall be possible through selection of icons to penetrate to individual functions described below.
  2. Work Orders:
    - a. Automatically generate work orders initiated from alarm conditions, accumulated run time or calendar time. Work orders generated shall specify a particular task to be accomplished including the labor, material and tools needed to accomplish work.
    - b. Include at least two of the following types of work orders:
      - 1) Corrective and emergency maintenance work orders shall be generated for a specific job or repair for emergency, breakdown, or scheduled work.
      - 2) Preventive maintenance that are used on a periodic basis to generate preventive maintenance work orders.
    - c. Include the following functions:
      - 1) Work Order Tracking: Perform every function related to processing work orders including creating, approving and initiating work orders, checking their status history and closing or reworking them when appropriate.
      - 2) Work Requests: Report any problems that require corrective maintenance activity generated by dispatchers and those people designated to request work orders.
      - 3) Quick Reporting: Report work done on an open work order or a small job.
      - 4) Work Manager: Specify the type of labor to be applied to a specific work order at specific times. It shall include the capability to dispatch one or more laborers to top-priority jobs on as-needed basis and to interrupt work in progress to reassign labor to higher priority tasks.
    - d. Reports:
      - 1) Equipment Cost Roll-up Report: Include a roll-up of equipment costs incurred since the date the report was last run.
      - 2) Delinquent Work Order Report: List open work orders whose target completion date is earlier than the date the report is run.
      - 3) Daily Work Order Assignment: List work orders that have labor assignments for the specified date.
      - 4) Estimated versus Actual Work Order Costs: List a cost summary of outstanding work orders.
      - 5) Open Work Orders Report: List open work orders for locations and equipment.
  3. Equipment:
    - a. Include equipment and location records; establish relationships between equipment, between locations, and between equipment and locations; track maintenance costs; and enter and review meter readings.
    - b. Include the following functions:
      - 1) Equipment: Store equipment numbers and corresponding information including equipment class, location, vendor, up/down status and maintenance costs for each piece of equipment. Include building of equipment assemblies. Equipment assemblies hierarchical ordering shall be provided for arrangement of buildings, departments, equipment and sub-assemblies.

- 2) Operating Locations: Facilitate creation of records for operating locations of equipment, and track equipment that is used in multiple locations. In addition, allow hierarchical organization of equipment operating in facility by means of grouping equipment locations into areas of responsibility.
  - 3) Failure Codes: Develop and display failure hierarchies to acquire an accurate history of types of failures that affect equipment and operating locations.
  - 4) Condition Monitoring: Display time related or limit measurements recorded for a piece of equipment. It shall be possible to generate work orders from this screen and to take immediate action on problem conditions.
- c. Reports:
- 1) Availability Statistic by Location: List equipment availability by location over a user-specified time period.
  - 2) Equipment Failure Summary: List total number of failures by problem code for a piece of equipment for a specified time period.
  - 3) Detailed Equipment Failure Report by Equipment: List of failure reports for the current piece of equipment for a specified time period.
  - 4) Equipment Hierarchy Report: List of equipment.
  - 5) Equipment History Graphs: Include a graphical report in histogram format that displays equipment breakdown history over a specified period.
  - 6) Equipment Measurement Report: Tabular listing and description of each measurement point for a piece of equipment and the history of measurements taken for that point.
  - 7) Maintenance Cost by Equipment: List of transactions costs for elected equipment in the specified date range.
  - 8) Failure Count by Equipment: Graphically report the number of failures for each piece of equipment showing number of failures for each piece of equipment over a specified time period, occurrence of each problem code within set of failures and failures by problem code.
  - 9) Failure Analysis Graphs: Graphically report number of failures for each piece of equipment over a specified time period, number of occurrences of each problem code within set of failures and failures by problem code.
  - 10) Failure Code Hierarchy Report: List of failure codes in each level of the failure hierarchy.
  - 11) Location Failure Summary: A summary for each selected location of failures reported and any hierarchy level locations for specified time period.
  - 12) Failure Summary by Location: A summary of failures for the selected location and their subordinate locations that are part of the hierarchical system.
  - 13) Detailed Failure Report by Location: List all failures for selected location and its subordinate locations that are part of a hierarchical system.
  - 14) Maintenance Cost by System: List of total costs reported in a given date range for locations in selected hierarchical system.
  - 15) Location Hierarchy Report: Lists member locations of a hierarchical system displayed in hierarchical fashion.
4. Calendars:
- a. Establish calendar records indicating working time for equipment, location, craft, and labor records.
5. Setup:
- a. Include configuration of database, security and setup applications.
6. Utilities:
- a. Include utilities module that allows system administrator to customize system and to maintain database.
  - b. Include the following functions:
    - 1) Interactive SQL: Include access to database for database management functions of import/export and backup.

- 2) Edit Windows: Display a dialog box to customize an application.
- 3) Archive Data: Remove records from database and store them for future reference.

D. Documentation:

1. Include complete documentation for the system consisting of a User Manual and Systems Administrator Guide.
2. User Manual shall describe how to use each application module and screen with step-by-step instructions detailing entry and retrieval of data for functions specified.
3. Include a step-by-step description of how each report is defined and retrieved.
4. Bind documentation and clearly title it indicating volume number and use.

## 2.17 CEA-709.1-C NETWORK HARDWARE

A. Routers:

1. Network routers, including routers configured as repeaters, shall comply with requirements of CEA-709.1-C and include connection between two or more CEA-709.3 TP/FT-10 channels or between two or more CEA-709.3 TP/FT-10 channels and a TP/XF-1250 channel.
2. IP Routers:
  - a. Perform layer three routing of CEA-709.1-C packets over an IP network according to CEA-852-B.
  - b. Include appropriate connection to the IP network and connections to CEA-709.3 TP/FT-10 or TP/XF-1250 network.
  - c. Support the Dynamic Host Configuration Protocol for IP configuration and use of an CEA-852-B Configuration Server (for CEA-852-B configuration), but shall not rely on these services for configuration.
  - d. Capable of manual configuration via a console RS-232 port.

B. Gateways:

1. Perform bidirectional protocol translation from one non-CEA-709.1-C protocol to CEA-709.1-C.
2. Incorporate a network connection to a TP/FT-10 network according to CEA-709.3 and a connection for a non-CEA-709.1-C network.

## 2.18 WIRELESS ROUTERS FOR OPERATOR INTERFACE

A. Single-Band Wireless Routers:

1. Description: High-speed router with integral Ethernet ports.
2. Compatibility: IEEE 802.11n/g/b/a wireless devices.
3. Ethernet Ports: Four, gigabit (1000 Mbps).
4. Wireless Security: Wi-Fi Protected Access (WPA) and WPA2 according to IEEE 802.11i.

B. Dual-Band Wireless Routers:

1. Description: High-speed, dual-band router with integral Ethernet ports and USB port.
2. Technology: IEEE 802.11n; 2.4- and 5-GHz speed bands.
3. Compatibility: IEEE 802.11n/g/b/a wireless devices.
4. Ethernet Ports: Four, gigabit (1000 Mbps).
5. USB Port: One, USB 2.0 or 3.0.
6. Wireless Security: Wi-Fi Protected Access (WPA) and WPA2 according to IEEE 802.11i.

## 2.19 DDC CONTROLLERS

- A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

- B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.
- C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.
- D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.
- E. Environment Requirements:
  - 1. Controller hardware shall be suitable for the anticipated ambient conditions.
  - 2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
  - 3. Controllers located outdoors shall be rated for operation at 40 to 150 deg F.
- F. Power and Noise Immunity:
  - 1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
- G. DDC Controller Spare Processing Capacity:
  - 1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
    - a. Network Controllers: 50 percent.
    - b. Programmable Application Controllers: Not less than 60percent.
    - c. Application-Specific Controllers: Not less than 70 percent.
  - 2. Memory shall support DDC controller's operating system and database and shall include the following:
    - a. Monitoring and control.
    - b. Energy management, operation and optimization applications.
    - c. Alarm management.
    - d. Historical trend data of all connected I/O points.
    - e. Maintenance applications.
    - f. Operator interfaces.
    - g. Monitoring of manual overrides.
- H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:
  - 1. Network Controllers:
    - a. 10 percent of each AI, AO, BI, and BO point connected to controller.
    - b. Minimum Spare I/O Points per Controller:
      - 1) AIs: Two
      - 2) AOs: Two
      - 3) BIs: Three
      - 4) BOs: Three
  - 2. Programmable Application Controllers:
    - a. 10 percent of each AI, AO, BI, and BO point connected to controller.
    - b. Minimum Spare I/O Points per Controller:
      - 1) AIs: Two
      - 2) AOs: Two
      - 3) BIs: Three
      - 4) BOs: Three
  - 3. Application-Specific Controllers:
    - a. 10 percent of each AI, AO, BI, and BO point connected to controller.
    - b. Minimum Spare I/O Points per Controller:
      - 1) AIs: Two
      - 2) AOs: Two
      - 3) BIs: Three

## 4) BOs: Three

- I. Maintenance and Support: Include the following features to facilitate maintenance and support:
  1. Mount microprocessor components on circuit cards for ease of removal and replacement.
  2. Means to quickly and easily disconnect controller from network.
  3. Means to quickly and easily access connect to field test equipment.
  4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.
  
- J. General Requirements for CEA-709.1-C DDC Controllers:
  1. Controllers shall be LonMark certified.
  2. Distinguishable and accessible switch, button, or pin, when pressed shall broadcast its 48-bit Node ID and Program ID over network.
  3. TP/FT-10 transceiver according to CEA-709.3 and connections for TP/FT-10 control network wiring.
  4. TP/XF-1250 transceiver according to CEA-709.3 and connections for TP/XF-1250 control network wiring.
  5. Communicate using CEA-709.1-C protocol.
  6. Controllers configured into subnets, as required, to comply with performance requirements indicated.
  7. Network communication through LNS network management and database standard for CEA-709.1-C network devices.
  8. Locally powered, not powered through network connection.
  9. Functionality required to support applications indicated, including, but not limited to, the following:
    - a. Input and outputs indicated and as required to support sequence of operation and application in which it is used. SNVTs shall have meaningful names identifying the value represented by an SNVT. Unless an SNVT of an appropriate engineering type is unavailable, all network variables shall be of an SNVT with engineering units appropriate to value the variable represents.
    - b. Configurable through SCPTs defined in LonMark SCPT List, operator-defined UCPTs, network configuration inputs (NCIs) of an SNVT type defined in LonMark SNVT List, NCIs of an operator-defined network variable type, or hardware settings on controller itself for all settings and parameters used by application in which it is used.
  10. Programmable controllers shall conform to LonMark Interoperability Guidelines and have LonMark certification.
  
- K. Input and Output Point Interface:
  1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
  2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
  3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
  4. AIs:
    - a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
    - b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
    - c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
    - d. Signal conditioning including transient rejection shall be provided for each AI.
    - e. Capable of being individually calibrated for zero and span.

- f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.
- 5. AOs:
  - a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
  - b. Output signals shall have a range of 4 to 20 mA dc or zero- to 10-V dc as required to include proper control of output device.
  - c. Capable of being individually calibrated for zero and span.
  - d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.
- 6. BIs:
  - a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
  - b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
  - c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
  - d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
  - e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.
- 7. BOs:
  - a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.
    - 1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.
    - 2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.
  - b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.
  - c. BOs shall be selectable for either normally open or normally closed operation.
  - d. Include tristate outputs (two coordinated BOs) for control of three-point floating-type electronic actuators without feedback.

## 2.20 NETWORK CONTROLLERS

- A. General Network Controller Requirements:
  - 1. Include adequate number of controllers to achieve performance indicated.
  - 2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
  - 3. Controller shall have enough memory to support its operating system, database, and programming requirements.
  - 4. Data shall be shared between networked controllers and other network devices.
  - 5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
  - 6. Controllers that perform scheduling shall have a real-time clock.
  - 7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
  - 8. Controllers shall be fully programmable.

- B. Communication:
  - 1. Network controllers shall communicate with other devices on DDC system Level one network.
  - 2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.
- C. Operator Interface:
  - 1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or mobile device.
  - 2. Local Keypad and Display:
    - a. Equip controller with local keypad and digital display for interrogating and editing data.
    - b. Use of keypad and display shall require security password.
- D. Serviceability:
  - 1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
  - 2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
  - 3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

## 2.21 PROGRAMMABLE APPLICATION CONTROLLERS

- A. General Programmable Application Controller Requirements:
  - 1. Include adequate number of controllers to achieve performance indicated.
  - 2. Controller shall have enough memory to support its operating system, database, and programming requirements.
  - 3. Data shall be shared between networked controllers and other network devices.
  - 4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
  - 5. Controllers that perform scheduling shall have a real-time clock.
  - 6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
  - 7. Controllers shall be fully programmable.
- B. Communication:
  - 1. Programmable application controllers shall communicate with other devices on network.
- C. Operator Interface:
  - 1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or mobile device.
  - 2. Local Keypad and Display:
    - a. Equip controller with local keypad and digital display for interrogating and editing data.
    - b. Use of keypad and display shall require security password.
- D. Serviceability:
  - 1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
  - 2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
  - 3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

## 2.22 APPLICATION-SPECIFIC CONTROLLERS

- A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.
  - 1. Capable of standalone operation and shall continue to include control functions without being connected to network.
  - 2. Data shall be shared between networked controllers and other network devices.
- B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.
- C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
- D. Serviceability:
  - 1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
  - 2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
  - 3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

## 2.23 CONTROLLER SOFTWARE

- A. General Controller Software Requirements:
  - 1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
  - 2. I/O points shall be identified by up to 30character point name and up to 16 character point descriptor. Same names shall be used at operator workstations.
  - 3. Control functions shall be executed within controllers using DDC algorithms.
  - 4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.
- B. Security:
  - 1. Operator access shall be secured using individual security passwords and user names.
  - 2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
  - 3. Operator log-on and log-off attempts shall be recorded.
  - 4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.
- C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:
  - 1. Weekly Schedule:
    - a. Include separate schedules for each day of week.
    - b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
    - c. Each schedule may consist of up to 10 events.
    - d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.
  - 2. Exception Schedules:
    - a. Include ability for operator to designate any day of the year as an exception schedule.



- b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.
  3. Holiday Schedules:
    - a. Include capability for operator to define up to 99 special or holiday schedules.
    - b. Schedules may be placed on scheduling calendar and will be repeated each year.
    - c. Operator shall be able to define length of each holiday period.
- D. System Coordination:
1. Include standard application for proper coordination of equipment.
  2. Application shall include operator with a method of grouping together equipment based on function and location.
  3. Group may then be used for scheduling and other applications.
- E. Binary Alarms:
1. Each binary point shall be set to alarm based on operator-specified state.
  2. Include capability to automatically and manually disable alarming.
- F. Analog Alarms:
1. Each analog object shall have both high and low alarm limits.
  2. Alarming shall be able to be automatically and manually disabled.
- G. Alarm Reporting:
1. Operator shall be able to determine action to be taken in event of an alarm.
  2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
  3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.
- H. Remote Communication:
1. System shall have ability to dial out in the event of an alarm.
- I. Electric Power Demand Limiting:
1. Demand-limiting program shall monitor building or other operator-defined electric power consumption from signals connected to electric power meter or from a watt transducer or current transformer.
  2. Demand-limiting program shall predict probable power demand such that action can be taken to prevent exceeding demand limit. When demand prediction exceeds demand limit, action will be taken to reduce loads in a predetermined manner. When demand prediction indicates demand limit will not be exceeded, action will be taken to restore loads in a predetermined manner.
  3. Demand reduction shall be accomplished by the following means:
    - a. Reset air-handling unit supply temperature set points.
    - b. Reset space temperature set points.
    - c. De-energize equipment based on priority.
  4. Demand-limiting parameters, frequency of calculations, time intervals, and other relevant variables shall be based on the means by which electric power service provider computes demand charges.
  5. Include demand-limiting prediction and control for any individual meter monitored by system or for total of any combination of meters.
  6. Include means operator to make the following changes online:
    - a. Addition and deletion of loads controlled.
    - b. Changes in demand intervals.
    - c. Changes in demand limit for meter(s).
    - d. Maximum shutoff time for equipment.
    - e. Minimum shutoff time for equipment.

- f. Select rotational or sequential shedding and restoring.
      - g. Shed and restore priority.
    - 7. Include the following information and reports, to be available on an hourly, daily, weekly, monthly and annual basis:
      - a. Total electric consumption.
      - b. Peak demand.
      - c. Date and time of peak demand.
      - d. Daily peak demand.
- J. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.
- K. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.
- L. Control Loops:
  - 1. Support any of the following control loops, as applicable to control required:
    - a. Two-position (on/off, open/close, slow/fast) control.
    - b. Proportional control.
    - c. Proportional plus integral (PI) control.
    - d. Proportional plus integral plus derivative (PID) control.
      - 1) Include PID algorithms with direct or reverse action and anti-windup.
      - 2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
      - 3) Controlled variable, set point, and PID gains shall be operator-selectable.
    - e. Adaptive (automatic tuning).
- M. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.
- N. Energy Calculations:
  - 1. Include software to allow instantaneous power or flow rates to be accumulated and converted to energy usage data.
  - 2. Include an algorithm that calculates a sliding-window average (rolling average). Algorithm shall be flexible to allow window intervals to be operator specified (such as 15, 30, or 60 minutes).
  - 3. Include an algorithm that calculates a fixed-window average. A digital input signal shall define start of window period (such as signal from utility meter) to synchronize fixed-window average with that used by utility.
- O. Anti-Short Cycling:
  - 1. BO points shall be protected from short cycling.
  - 2. Feature shall allow minimum on-time and off-time to be selected.
- P. On and Off Control with Differential:
  - 1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
  - 2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.
- Q. Run-Time Totalization:
  - 1. Include software to totalize run-times for all BI points.
  - 2. A high run-time alarm shall be assigned, if required, by operator.

## 2.24 ENCLOSURES

- A. General Enclosure Requirements:
1. House each controller and associated control accessories in a enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
  2. Do not house more than one controller in a single enclosure.
  3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
  4. Equip doors of enclosures housing controllers and components with analog or digital displays with windows to allow visual observation of displays without opening enclosure door.
- B. Internal Arrangement:
1. Internal layout of enclosure shall group and protect electric, and electronic components associated with a controller, but not an integral part of controller.
  2. Arrange layout to group similar products together.
  3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
  4. Factory or shop install products, cabling and wiring complying with requirements and standards indicated.
  5. Terminate field cable and wire using heavy-duty terminal blocks.
  6. Include spare terminals, equal to not less than **10** percent of used terminals.
  7. Include spade lugs for stranded cable and wire.
  8. Install a maximum of two wires on each side of a terminal.
  9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
  10. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
  11. Mount products within enclosure on removable internal panel(s).
  12. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch-high lettering.
  13. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.
  14. Size enclosure internal panel to include at least 25 percent spare area on face of panel.
- C. Environmental Requirements:
1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
  2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
  3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
  4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
  5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.
  6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

- D. Wall-Mounted, NEMA 250, Type 1:
1. Enclosure shall be NRTL listed according to UL 50 or UL 50E.
- E. Wall Mounted NEMA 250, Types 4 and 12:
1. Enclosure shall be NRTL listed according to UL 508A.
  2. Seam and joints are continuously welded and ground smooth.
- F. Wall-Mounted, NEMA 250, Type 4X SS:
1. Enclosure shall be NRTL listed according to UL 508A.
  2. Seam and joints are continuously welded and ground smooth.
  3. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
  4. Internal panel mounting studs and hardware, grounding hardware, and sealing washers.
  5. Install corrosion-resistant polyester vent drain in a stainless-steel sleeve at the bottom of enclosure.
  6. Include enclosure with stainless-steel mounting brackets.
- G. Freestanding, NEMA 250, Type 1:
1. Enclosure shall be NRTL listed according to UL 508A.
  2. Seam and joints are continuously welded and ground smooth.
  3. Externally formed body flange around perimeter of enclosure face.
- H. Freestanding, NEMA 250, Types 4 and 12:
1. Enclosure shall be NRTL listed according to UL 508A.
  2. Seam and joints are continuously welded and ground smooth.
  3. Externally formed body flange around perimeter of enclosure face.
  4. Type 12 Enclosure Sizes:
    - a. Single-door enclosure sizes up to 90 inches tall by 36 inches wide
    - b. Double-door enclosure sizes up to 90 inches tall by 72 inches wide
  5. Type 4 Enclosure Sizes:
    - a. Single-door enclosure sizes up to 72 inches tall by 36 inches wide
  6. Construct enclosure of steel, not less than 0.093 inch thick.
  7. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
    - a. Exterior color shall be ANSI 61 gray.
    - b. Interior color shall be ANSI 61 gray.
  8. Corner-formed door with continuous perimeter oil-resistant gasket supported using continuous piano hinge full length of door.
  9. Doors fitted with three-point (top, middle, and bottom) latch system with latching rod rollers and single, heavy-duty oil-tight handle with integral locking mechanism.
  10. Removable solid steel internal panel, 0.093 inch thick, with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
  11. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
  12. Grounding stud on enclosure body.
  13. Thermoplastic pocket on inside of door for record Drawings and Product Data.
  14. Top of enclosure fitted with no fewer than two lifting eyes.
  15. Internal rack-mount shelves and angles as required by application.
- I. Accessories:
1. Electric Heater:
    - a. Aluminum housing with brushed finish.
    - b. Thermostatic control with adjustable set point from zero to 100 deg F
    - c. Capacity: 100, 200, 400, and 800 W as required by application.
    - d. Fan draws cool air from bottom of enclosure and passes air across thermostat and heating elements before being released into enclosure cavity. Heated air is discharged through the top of heater.

2. Ventilation Fans, Filtered Intake and Exhaust Grilles:
  - a. Number and size of fans, filters and grilles as required by application.
  - b. Compact cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
  - c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
  - d. Thermostatic control with adjustable set point from 32 to 140 deg F
3. Air Conditioner:
  - a. Electric-powered, self-contained air-conditioning unit specially designed for electrical enclosures to maintain temperature inside enclosure below ambient temperature outside enclosure.
  - b. Thermostatic control with adjustable set point from 60 to 120 deg F
  - c. Enclosure side or top mounting with unit capacity as required by application.
  - d. Designed for closed-loop cooling with continuous operation in ambient environments up to 125 deg F
  - e. HFC refrigerant.
  - f. Reusable and washable air filter.
  - g. High-performance, industrial-grade, and high-efficiency fans.
  - h. Furnished with power cord and polarized plug for power connection.
  - i. Condensate management system with base pan side drain.
  - j. Mounting hardware, gaskets, mounting template and instruction manual furnished with unit.
  - k. Outdoor units equipped with head pressure control for low ambient operation, compressor heater, coated condenser coil and thermostat.
4. Framed Fixed Window Kit for NEMA 250, Types 4, 4X, and 12 Enclosures:
  - a. 0.25-inch- thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.
  - b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.
  - c. Window kit shall be factory or shop installed before shipment to Project.
5. Frameless Fixed Window Kit for NEMA 250, Type 1 Enclosures:
  - a. 0.125-inch- thick, polycarbonate window mounted in enclosure door material.
  - b. Window attached to door with screw fasteners and continuous strip of high-strength double-sided tape around window perimeter.
  - c. Window kit shall be factory or shop installed before shipment to Project.
6. Frame Fixed or Hinged Window Kit for NEMA 250, Types 1 and 12 Enclosures:
  - a. 0.25-inch- thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.
  - b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.
  - c. Window kit shall be factory or shop installed before shipment to Project.
7. Bar handle with keyed cylinder lock set.

## 2.25 RELAYS

- A. General-Purpose Relays:
  1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
  2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
  3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
  4. Construct the contacts of either silver cadmium oxide or gold.
  5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
  6. Relays shall have LED indication and a manual reset and push-to-test button.
  7. Performance:
    - a. Mechanical Life: At least 10 million cycles.

- b. Electrical Life: At least 100,000 cycles at rated load.
  - c. Pickup Time: 15 ms or less.
  - d. Dropout Time: 10 ms or less.
  - e. Pull-in Voltage: 85 percent of rated voltage.
  - f. Dropout Voltage: 50 percent of nominal rated voltage.
  - g. Power Consumption: 2 VA.
  - h. Ambient Operating Temperatures: Minus 40 to 115 deg F
8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
  9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
  10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.
- B. Multifunction Time-Delay Relays:
1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
  2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
  3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
  4. Construct the contacts of either silver cadmium oxide or gold.
  5. Enclose the relay in a dust-tight cover.
  6. Include knob and dial scale for setting delay time.
  7. Performance:
    - a. Mechanical Life: At least 10 million cycles.
    - b. Electrical Life: At least 100,000 cycles at rated load.
    - c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
    - d. Repeatability: Within 2 percent.
    - e. Recycle Time: 45 ms.
    - f. Minimum Pulse Width Control: 50 ms.
    - g. Power Consumption: 5 VA or less at 120-V ac.
    - h. Ambient Operating Temperatures: Minus 40 to 115 deg F
  8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
  9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
  10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.
- C. Latching Relays:
1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
  2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
  3. Use a plug-in-style relay with a multibladed plug.
  4. Construct the contacts of either silver cadmium oxide or gold.
  5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
  6. Performance:
    - a. Mechanical Life: At least 10 million cycles.
    - b. Electrical Life: At least 100,000 cycles at rated load.
    - c. Pickup Time: 15 ms or less.
    - d. Dropout Time: 10 ms or less.
    - e. Pull-in Voltage: 85 percent of rated voltage.
    - f. Dropout Voltage: 50 percent of nominal rated voltage.
    - g. Power Consumption: 2 VA.
    - h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
  7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
  8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.

9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.
- D. Current Sensing Relay:
1. Monitors ac current.
  2. Independent adjustable controls for pickup and dropout current.
  3. Energized when supply voltage is present and current is above pickup setting.
  4. De-energizes when monitored current is below dropout current.
  5. Dropout current is adjustable from 50 to 95 percent of pickup current.
  6. Include a current transformer, if required for application.
  7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.
- E. Combination On-Off Status Sensor and On-Off Relay:
1. Description:
    - a. On-off control and status indication in a single device.
    - b. LED status indication of activated relay and current trigger.
    - c. Closed-Open-Auto override switch located on the load side of the relay.
  2. Performance:
    - a. Ambient Temperature: Minus 30 to 140 deg F
    - b. Voltage Rating: Single-phase loads rated for 300-V ac. Three-phase loads rated for 600-V ac.
  3. Status Indication:
    - a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
    - b. Current Sensor Range: As required by application.
    - c. Current Set Point: [Fixed] [Adjustable] [Fixed or adjustable as required by application].
    - d. Current Sensor Output:
      - 1) Solid-state, single-pole double-throw contact rated for 30-V ac and dc and for 0.4 A.
      - 2) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.
      - 3) Analog, zero- to 5- or 10-V dc.
      - 4) Analog, 4 to 20 mA, loop powered.
  4. Relay: Single-pole double-throw, continuous-duty coil; rated for 10-million mechanical cycles.
  5. Enclosure: NEMA 250, Type 1 enclosure.

## 2.26 ELECTRICAL POWER DEVICES

- A. Transformers:
1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
  2. Transformer shall be at least 40 VA.
  3. Transformer shall have both primary and secondary fuses.
- B. Power-Line Conditioner:
1. General Power-Line Conditioner Requirements:
    - a. Design to ensure maximum reliability, serviceability and performance.
    - b. Overall function of the power-line conditioner is to receive raw, polluted electrical power and purify it for use by electronic equipment. The power-line conditioner shall provide isolated, regulated, transient and noise-free sinusoidal power to loads served.
  2. Standards: NRTL listed per UL 1012.
  3. Performance:

- a. Single phase, continuous, 100 percent duty rated KVA/KW capacity. Design to supply power for linear or nonlinear, high crest factor, resistive and reactive loads.
  - b. Automatically regulate output voltage to within 2 percent or better with input voltage fluctuations of plus 10 to minus 20 percent of nominal when system is loaded 100 percent. Use Variable Range Regulation to obtain improved line voltage regulation when operating under less than full load conditions.
    - 1) At 75 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 35 percent of nominal.
    - 2) At 50 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 40 percent of nominal.
    - 3) At 25 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 45 percent of nominal.
  - c. With input voltage distortion of up to 40 percent, limit the output voltage sine wave to a maximum harmonic content of 5 percent.
  - d. Automatically regulate output voltage to within 2.5 percent when load (resistive) changes from zero percent to 100 percent to zero percent.
  - e. Output voltage returns to 95 percent of nominal level within two cycles and to 100 percent within three cycles when the output is taken from no load to full resistive load or vice-versa. Recovery from partial resistive load changes is corrected in a shorter period of time.
  - f. K Factor: 30, designed to operate with nonlinear, non-sinusoidal, high crest factor loads without overheating.
  - g. Input power factor within 0.95 approaching unity with load power factor as poor as 0.6.
  - h. Attenuate load-generated odd current harmonics 23 dB at the input.
  - i. Electrically isolate the primary from the secondary. Meet isolation criteria as defined in NFPA 70, Article 250-5D.
  - j. Lighting and Surge Protection: Compares to UL 1449 rating of 330 V when subjected to Category B3 (6000 V/3000 A) combination waveform as established by IEEE C62.41.
  - k. Common-mode noise attenuation of 140 dB.
  - l. Transverse-mode noise attenuation of 120 dB.
  - m. With loss of input power for up to 16.6 ms, the output sine wave remains at usable ac voltage levels.
  - n. Reliability of 200,000 hours' MTBF.
  - o. At full load, when measured at 1-m distance, audible noise is not to exceed 54 dB.
  - p. Approximately 92 percent efficient at full load.
4. Transformer Construction:
- a. Ferroresonant, dry type, convection cooled, 600V class. Transformer windings of Class H (220 deg C) insulated copper.
  - b. Use a Class H installation system throughout with operating temperatures not to exceed 150 deg C over a 40-deg C ambient temperature.
  - c. Configure transformer primary for multi-input voltage. Include input terminals for source conductors and ground.
  - d. Manufacture transformer core using M-6 grade, grain-oriented, stress-relieved transformer steel.
  - e. Configure transformer secondary in a 240/120-V split with a 208-V tap or straight 120 V, depending on power output size.
  - f. Electrically isolate the transformer secondary windings from the primary windings. Bond neutral conductor to cabinet enclosure and output neutral terminal.
  - g. Include interface terminals for output power hot, neutral and ground conductors.
  - h. Label leads, wires and terminals to correspond with circuit wiring diagram.
  - i. Vacuum impregnate transformer with epoxy resin.



5. Cabinet Construction:
  - a. Design for panel or floor mounting.
  - b. NEMA 250, Type 1, general-purpose, indoor enclosure.
  - c. Manufacture the cabinet from heavy gauge steel complying with UL 50.
  - d. Include a textured baked-on paint finish.
  
- C. Transient Voltage Suppression and High-Frequency Noise Filter Unit:
  1. The maximum continuous operating voltage shall be at least 125 percent.
  2. The operating frequency range shall be 47 to 63 Hz.
  3. Protection modes according to NEMA LS-1.
  4. The rated single-pulse surge current capacity, for each mode of protection, shall be no less than the following:
    - a. Line to Neutral: 45,000 A.
    - b. Neutral to Ground: 45,000 A.
    - c. Line to Ground: 45,000 A.
    - d. Per Phase: 90,000 A.
  5. Clamping voltages shall be in compliance with test and evaluation procedures defined in NEMA LS-1. Maximum clamping voltage shall be as follows:
    - a. Line to Neutral: 360 V.
    - b. Line to Ground: 360 V.
    - c. Neutral to Ground: 360 V.
  6. Electromagnetic interference and RF interference noise rejection or attenuation values shall comply with test and evaluation procedures defined in NEMA LS-1.
    - a. Line to Neutral:
      - 1) 100 kHz: 42 dB.
      - 2) 1 MHz: 25 dB.
      - 3) 10 MHz: 21 dB.
      - 4) 100 MHz: 36 dB.
    - b. Line to Ground:
      - 1) 100 kHz: 16 dB.
      - 2) 1 MHz: 55 dB.
      - 3) 10 MHz: 81 dB.
      - 4) 100 MHz: 80 dB.
  7. Unit shall have LED status indicator that extinguishes to indicate a failure.
  8. Unit shall be listed by an NRTL as a transient voltage surge suppressor per UL 1449, and as an electromagnetic interference filter per UL 1283.
  9. Unit shall not generate any appreciable magnetic field.
  10. Unit shall not generate an audible noise.
  
- D. DC Power Supply:
  1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
  2. Enclose circuitry in a housing.
  3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
  4. Performance:
    - a. Output voltage nominally 25-V dc within 5 percent.
    - b. Output current up to 100 mA.
    - c. Input voltage nominally 120-V ac, 60 Hz.
    - d. Load regulation within 0.5 percent from zero- to 100-mA load.
    - e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
    - f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

## 2.27 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS FOR WORKSTATIONS

- A. 250 through 1000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
  - a. Larger-capacity units shall be provided for systems with larger connected loads.
  - b. UPS shall provide five minutes of battery power.
3. Performance:
  - a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
  - b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
  - c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
  - d. On Battery Output Voltage: Sine wave.
  - e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
  - f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
  - g. Transfer Time: 6 ms.
  - h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.
4. UPS shall be automatic during fault or overload conditions.
5. Unit with integral line-interactive, power condition topology to eliminate all power contaminants.
6. Include front panel with power switch and visual indication of power, battery, fault and temperature.
7. Unit shall include an audible alarm of faults and front panel silence feature.
8. Unit with four NEMA WD 1, NEMA WD 6 Configuration 5-15R receptacles.
9. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure).
10. Batteries shall be sealed lead-acid type and be maintenance free. Battery replacement shall be front accessible by user without dropping load.
11. Include tower models installed in ventilated cabinets to the particular installation location.

## 2.28 CONTROL WIRE AND CABLE

- A. Wire: Single conductor control wiring above 24 V.
  1. Wire size shall be at least No. 18 AWG.
  2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
  3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
  4. Conductor colors shall be black (hot), white (neutral), and green (ground).
  5. Furnish wire on spools.
- B. Single Twisted Shielded Instrumentation Cable above 24 V:
  1. Wire size shall be a minimum No. 18 AWG.
  2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
  3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
  4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
  5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
  6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
  7. Furnish wire on spools.
- C. Single Twisted Shielded Instrumentation Cable 24 V and Less:
  1. Wire size shall be a minimum No. 18 AWG.
  2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.

3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
  4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
  5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
  6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
  7. Furnish wire on spools.
- D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.
1. Cable shall be balanced twisted pair.
  2. Comply with the following requirements and for balanced twisted pair cable described in [Section 260523 "Control-Voltage Electrical Power Cables."] [Section 271513 "Communications Copper Horizontal Cabling."]
    - a. Cable shall be plenum rated.
    - b. Cable shall have a unique color that is different from other cables used on Project.

## **2.29 RACEWAYS**

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.
- B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for raceways for balanced twisted pair cables and optical fiber cables.

## **2.30 OPTICAL FIBER CABLE AND CONNECTORS**

- A. Comply with requirements in Section 271323 "Communications Optical Fiber Backbone Cabling" for optical fiber backbone cabling and connectors.
- B. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for optical fiber horizontal cabling and connectors.

## **2.31 ACCESSORIES**

- A. Damper Blade Limit Switches:
  1. Sense positive open and/or closed position of the damper blades.
  2. NEMA 250, Type 13, oil-tight construction.
  3. Arrange for the mounting application.
  4. Additional waterproof enclosure when required by its environment.
  5. Arrange to prevent "over-center" operation.
- B. Instrument Enclosures:
  1. Include instrument enclosure for secondary protection to comply with requirements indicated in "Performance Requirements" Article.
  2. NRTL listed and labeled to UL 50.
  3. Sized to include at least 25 percent spare area on subpanel.
  4. Instrument(s) mounted within enclosure on internal subpanel(s).
  5. Enclosure face with engraved, laminated phenolic nameplate for each instrument within enclosure.
  6. Enclosures larger than **12 inches** shall have a hinged full-size face cover.
  7. Equip enclosure with lock and common key.

- C. Manual Valves:
1. Ball Type:
    - a. Body: Bronze ASTM B62 or ASTM B61.
    - b. Ball: Type 316 stainless steel.
    - c. Stem: Type 316 stainless steel.
    - d. Seats: Reinforced PTFE.
    - e. Packing Ring: Reinforced PTFE.
    - f. Lever: Stainless steel with a vinyl grip.
    - g. 600 WOG.
    - h. Threaded end connections.
- D. Wall-Mounted Portable Workstation Cabinet:
1. Surface-mounted wall cabinet for tilt-out operation of laptop computers and large-format mobile devices.
  2. Cabinet shall have a load limit of 50 lb (23 kg).
  3. Cabinet shall include the following:
    - a. Oil-filled dampers for controlled lowering of equipment to operational position.
    - b. 3RU EIA mounting rails.
    - c. Removable laptop shelf.
    - d. Separate top compartment with mounting area, hinged rail and security lock.
    - e. Front ventilation slots.
    - f. Knockouts for conduit connections on top and bottom of cabinet.
  4. Cabinet shall be constructed of steel and painted with a powder-coat epoxy.
  5. Inside center of backbox shall have provision to mount a field-furnished and -installed, single gang electrical outlet box.

## 2.32 IDENTIFICATION

- A. Instrument Air Pipe and Tubing:
1. Engraved tag shall bear the following information:
    - a. Service (Example): "Instrument Air."
    - b. Pressure Range (Example): 0 to 30 psig .
  2. Letter size shall be a minimum of 0.25 inch high.
  3. Tag shall consist of white lettering on blue background.
  4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded blue with contrasting white center exposed by engraving through outer layer.
  5. Include tag with a brass grommet, chain and S-hook.
- B. Control Equipment, Instruments, and Control Devices:
1. Self-adhesive label, Laminated acrylic or melamine plastic sign bearing unique identification.
    - a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.
  2. Legend shall consist of white lettering on black background.
  3. Laminated acrylic or melamine plastic sign shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer and shall be fastened with drive pins.
  4. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require additional identification.
- C. Raceway and Boxes:
1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.
- D. Equipment Warning Labels:
1. Self-adhesive label with pressure-sensitive adhesive back and peel-off protective jacket.
  2. Lettering size shall be at least 14-point type with white lettering on red background.
  3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
  4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

### **2.33 SOURCE QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to evaluate the following according to industry standards for each product, and to verify DDC system reliability specified in performance requirements:
1. DDC controllers.
  2. Gateways.
  3. Routers.
  4. Operator workstations.
- B. Product(s) and material(s)] will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Verify compatibility with and suitability of substrates.
- B. Examine roughing-in for products to verify actual locations of connections before installation.
1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
  2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT**

- A. Communication Interface to Equipment with Integral Controls:
1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.
  2. Equipment to Be Connected:

- a. Dedicated outdoor-air units specified in Section 237433 "Dedicated Outdoor-Air Units."
- b. Variable refrigerant systems specified in Section 238129.

### **3.03 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS**

- A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.
- B. Deliver the following to duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.
  1. DDC control dampers, which are specified in Section 230923.12 "DDC Control Dampers."

### **3.04 CONTROL DEVICES FOR EQUIPMENT MANUFACTURER FACTORY INSTALLATION**

- A. Deliver the following to air-handling unit manufacturer for factory installation. Include installation instructions to air-handling unit manufacturer.
  1. Programmable application or application-specific controller.
  2. Unit-mounted DDC control dampers and actuators, which are specified in Section 230923.12 "Control Dampers."
  3. Relays.
- B. Deliver the following to terminal unit manufacturer for factory installation. Include installation instructions to terminal unit manufacturer.
  1. Programmable application or application-specific controller.
  2. Electric damper actuator. Dampers actuators are specified in Section 230923.12 "Control Dampers."
- C. Deliver the following to fan-coil unit manufacturer for factory installation. Include installation instructions to fan-coil unit manufacturer.
  1. Programmable application or application-specific controller.
  2. Unit-mounted temperature sensors. Air-temperature sensors, switches, and transmitters are specified in Section 230923.27 "Temperature Instruments."
  3. Relays.

### **3.05 GENERAL INSTALLATION REQUIREMENTS**

- A. Install products to satisfy more stringent of all requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment.
- D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.
- E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- F. Firestop Penetrations Made in Fire-Rated Assemblies: Comply with requirements in Section 078413 "Penetration Firestopping."

- G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."
- H. Welding Requirements:
  - 1. Restrict welding and burning to supports and bracing.
  - 2. No equipment shall be cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.
  - 3. Welding, where approved, shall be by inert-gas electric arc process and shall be performed by qualified welders according to applicable welding codes.
  - 4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.
- I. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.
- J. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.
- K. Corrosive Environments:
  - 1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:
    - a. Laboratory exhaust-air streams.
    - b. Process exhaust-air streams.
  - 2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
  - 3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### **3.06 WORKSTATION INSTALLATION**

- A. Desktop Workstations Installation:
  - 1. Install workstation(s) at location(s) directed by Owner.
  - 2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
  - 3. Install software on workstation(s) and verify software functions properly.
  - 4. Develop Project-specific graphics, trends, reports, logs and historical database.
  - 5. Power each workstation through a dedicated UPS unit. Locate UPS adjacent to workstation.
- B. Portable Workstations Installation:
  - 1. Turn over portable workstations to Owner at Substantial Completion.
  - 2. Install software on workstation(s) and verify software functions properly.
- C. Color Graphics Application:
  - 1. Use system schematics indicated as starting point to create graphics.
  - 2. Develop Project-specific library of symbols for representing system equipment and products.

3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
4. Refine graphics as necessary for Owner acceptance.
5. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

### **3.07 POT INSTALLATION**

- A. Install one portable operator terminal(s).
- B. Turn over POTs to Owner at Substantial Completion.
- C. Install software on each POT and verify that software functions properly.

### **3.08 ROUTER INSTALLATION**

- A. Install routers if required for DDC system communication interface requirements indicated.
  1. Install router(s) required to suit indicated requirements.
    - a. <Insert requirements>.
- B. Test router to verify that communication interface functions properly.

### **3.09 CONTROLLER INSTALLATION**

- A. Install controllers in enclosures to comply with indicated requirements.
- B. Connect controllers to field power supply.
- C. Install controller with latest version of applicable software and configure to execute requirements indicated.
- D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.
- E. Installation of Network Controllers:
  1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  2. Install controllers in a protected location that is easily accessible by operators.
- F. Installation of Programmable Application Controllers:
  1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  2. Install controllers in a protected location that is easily accessible by operators.
- G. Application-Specific Controllers:
  1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

### **3.10 INSTALLATION OF WIRELESS ROUTERS FOR OPERATOR INTERFACE**

- A. Install wireless routers to achieve optimum performance and best possible coverage.



- B. Mount wireless routers in a protected location that is within 60 inches of floor and easily accessible by operators.
- C. Connect wireless routers to field power supply and to UPS units if network controllers are powered through UPS units.
- D. Install wireless router with latest version of applicable software and configure wireless router with WPA2 security and password protection. Create access password with not less than 12 characters consisting of letters and numbers and at least one special character. Document password in operations and maintenance manuals for reference by operators.
- E. Test and adjust wireless routers for proper operation with portable workstation and other wireless devices intended for use by operators.

### 3.11 ENCLOSURES INSTALLATION

- A. Install the following items in enclosures, to comply with indicated requirements:
  - 1. Gateways.
  - 2. Routers.
  - 3. Controllers.
  - 4. Electrical power devices.
  - 5. UPS units.
  - 6. Relays.
  - 7. Accessories.
  - 8. Instruments.
  - 9. Actuators
  - 10. <Insert devices>.
- B. Attach wall-mounted enclosures to wall using the following types of steel struts:
  - 1. For NEMA 250, Type 1 Enclosures: Use galvanized-steel.
  - 2. For NEMA 250, **Type 4X** Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
  - 3. Install plastic caps on exposed cut edges of strut.
- C. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

### 3.12 ELECTRIC POWER CONNECTIONS

- A. Connect electrical power to DDC system products requiring electrical power connections.
- B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.
- C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.
- D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.
- E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

**3.13 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification products and installation.
- B. Install self-adhesive labels, laminated acrylic or melamine plastic signs with unique identification on face for each of the following:
  - 1. Operator workstation.
  - 2. Server.
  - 3. Printer.
  - 4. Gateway.
  - 5. Router.
  - 6. Protocol analyzer.
  - 7. DDC controller.
  - 8. Enclosure.
  - 9. Electrical power device.
  - 10. UPS unit.
  - 11. Accessory.
- C. Install unique instrument identification on face of each instrument connected to a DDC controller.
- D. Install unique identification on face of each control damper actuator connected to a DDC controller.
- E. Where product is installed above accessible tile ceiling, also install matching identification on face of ceiling grid located directly below.
- F. Where product is installed above an inaccessible ceiling, also install identification on face of access door directly below.
- G. Warning Labels and Signs:
  - 1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
  - 2. Shall be located in highly visible location near power service entry points.

**3.14 NETWORK INSTALLATION**

- A. Install optical fiber cable when connecting between the following network devices and when located in different buildings on campus, or when distance between devices exceeds
  - 1. Operator workstations.
  - 2. Operator workstations and network controllers.
  - 3. Network controllers.
- B. Install balanced twisted pair cable when connecting between the following network devices:
  - 1. Operator workstations.
  - 2. Operator workstations and network controllers.
  - 3. Network controllers.
- C. Install balanced twisted pair or copper cable (as required by equipment) when connecting between the following:
  - 1. Gateways.
  - 2. Gateways and network controllers or programmable application controllers.
  - 3. Routers.
  - 4. Routers and network controllers or programmable application controllers.

5. Network controllers and programmable application controllers.
6. Programmable application controllers.
7. Programmable application controllers and application-specific controllers.
8. Application-specific controllers.
9. <Insert network device>.

D. Install cable in continuous raceway.

1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

### 3.15 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:

1. MAC Address:
  - a. Every network device shall have an assigned and documented MAC address unique to its network.
  - b. Ethernet Networks: Document MAC address assigned at its creation.
  - c. ARCNET or MS/TP networks: Assign from 00 to 64.
2. Network Numbering:
  - a. Assign unique numbers to each new network.
  - b. Provide ability for changing network number through device switches or operator interface.
  - c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.
3. Device Object Identifier Property Number:
  - a. Assign unique device object identifier property numbers or device instances for each device network.
  - b. Provide for future modification of device instance number by device switches or operator interface.
  - c. LAN shall support up to 4,194,302 unique devices.
4. Device Object Name Property Text:
  - a. Device object name property field shall support 32 minimum printable characters.
  - b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.
    - 1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
    - 2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".
5. Object Name Property Text for Other Than Device Objects:
  - a. Object name property field shall support 32 minimum printable characters.
  - b. Assign object name properties with plain-English names descriptive of application.
    - 1) Example 1: "Zone 1 Temperature."
    - 2) Example 2 "Fan Start and Stop."
6. Object Identifier Property Number for Other Than Device Objects:
  - a. Assign object identifier property numbers according to Drawings or tables indicated.
  - b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

### 3.16 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

- B. Wire and Cable Installation:
1. Comply with installation requirements in Section 260523 "Control-Voltage Electrical Power Cables."
  2. Comply with installation requirements in Section 271313 "Communications Copper Backbone Cabling."
  3. Comply with installation requirements in Section 271513 "Communications Copper Horizontal Cabling."
  4. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.
    - a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.
  5. Terminate wiring in a junction box.
    - a. Clamp cable over jacket in junction box.
    - b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.
  6. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
  7. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
  8. Use shielded cable to transmitters.
  9. Use shielded cable to temperature sensors.
  10. Perform continuity and meager testing on wire and cable after installation.
- C. Conduit Installation:
1. Comply with Section "260533 "Raceways and Boxes for Electrical Systems" for control-voltage conductors.
  2. Comply with Section 270528 "Pathways for Communications Systems" for balanced twisted pair cabling and optical fiber installation.

### **3.17 OPTICAL FIBER CABLE SYSTEM INSTALLATION**

- A. Comply with installation requirements in Section 271323 "Communications Optical Fiber Backbone Cabling."
- B. Comply with installation requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling."

### **3.18 FIELD QUALITY CONTROL**

- A. Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative]:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Testing:
1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.

2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use an optical fiber time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.

### **3.19 DDC SYSTEM I/O CHECKOUT PROCEDURES**

- A. Check installed products before continuity tests, leak tests and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
- D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.
- E. Control Damper Checkout:
  1. Verify that control dampers are installed correctly for flow direction.
  2. Verify that proper blade alignment, either parallel or opposed, has been provided.
  3. Verify that damper frame attachment is properly secured and sealed.
  4. Verify that damper actuator and linkage attachment is secure.
  5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
  6. Verify that damper blade travel is unobstructed.
- F. Instrument Checkout:
  1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
  2. Verify that attachment is properly secured and sealed.
  3. Verify that conduit connections are properly secured and sealed.
  4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
  5. Inspect instrument tag against approved submittal.
  6. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
  7. For temperature instruments:
    - a. Verify sensing element type and proper material.
    - b. Verify length and insertion.

**3.20 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:**

- A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
- B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
- C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
- D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.
- E. Provide diagnostic and test equipment for calibration and adjustment.
- F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
- G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
- H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
- I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.
- J. Analog Signals:
  - 1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
  - 2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
  - 3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.
- K. Digital Signals:
  - 1. Check digital signals using a jumper wire.
  - 2. Check digital signals using an ohmmeter to test for contact making or breaking.
- L. Control Dampers:
  - 1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
  - 2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
  - 3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
  - 4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
- M. Control Valves:
  - 1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.

2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
  3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
  4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
- N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.
- O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
- P. Switches: Calibrate switches to make or break contact at set points indicated.
- Q. Transmitters:
1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
  2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

### **3.21 DDC SYSTEM CONTROLLER CHECKOUT**

- A. Verify power supply.
1. Verify voltage, phase and hertz.
  2. Verify that protection from power surges is installed and functioning.
  3. Verify that ground fault protection is installed.
  4. If applicable, verify if connected to UPS unit.
  5. If applicable, verify if connected to a backup power source.
  6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.
- B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.
- C. Verify that spare I/O capacity is provided.

### **3.22 DDC CONTROLLER I/O CONTROL LOOP TESTS**

- A. Testing:
1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
  2. Test every I/O point throughout its full operating range.
  3. Test every control loop to verify operation is stable and accurate.
  4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
  5. Test and adjust every control loop for proper operation according to sequence of operation.
  6. Test software and hardware interlocks for proper operation. Correct deficiencies.
  7. Operate each analog point at the following:
    - a. Upper quarter of range.
    - b. Lower quarter of range.
    - c. At midpoint of range.
  8. Exercise each binary point.

9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desired results.

### 3.23 DDC SYSTEM VALIDATION TESTS

- A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.
- B. After approval of Test Plan, execute all tests and procedures indicated in plan.
- C. After testing is complete, submit completed test checklist.
- D. Pretest Checklist: Submit the following list with items checked off once verified:
  1. Detailed explanation for any items that are not completed or verified.
  2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
  3. HVAC equipment motors operate below full-load amperage ratings.
  4. Required DDC system components, wiring, and accessories are installed.
  5. Installed DDC system architecture matches approved Drawings.
  6. Control electric power circuits operate at proper voltage and are free from faults.
  7. Required surge protection is installed.
  8. DDC system network communications function properly, including uploading and downloading programming changes.
  9. Using BACnet protocol analyzer, verify that communications are error free.
  10. Each controller's programming is backed up.
  11. Equipment, products, wiring cable and conduits are properly labeled.
  12. All I/O points are programmed into controllers.
  13. Testing, adjusting and balancing work affecting controls is complete.
  14. Dampers and actuators zero and span adjustments are set properly.
  15. Each control damper and actuator goes to failed position on loss of power.
  16. Valves and actuators zero and span adjustments are set properly.
  17. Each control valve and actuator goes to failed position on loss of power.
  18. Meter, sensor and transmitter readings are accurate and calibrated.
  19. Control loops are tuned for smooth and stable operation.
  20. View trend data where applicable.
  21. Each controller works properly in standalone mode.
  22. Safety controls and devices function properly.
  23. Interfaces with fire-alarm system function properly.
  24. Electrical interlocks function properly.
  25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphics are created.
  26. Record Drawings are completed.
- E. Test Plan:
  1. Prepare and submit a validation test plan including test procedures for performance validation tests.
  2. Test plan shall address all specified functions of DDC system and sequences of operation.
  3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
  4. Explain method for simulating necessary conditions of operation used to demonstrate performance.



5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 15 business days before start of tests.

F. Validation Test:

1. Verify operating performance of each I/O point in DDC system.
  - a. Verify analog I/O points at operating value.
  - b. Make adjustments to out-of-tolerance I/O points.
    - 1) Identify I/O points for future reference.
    - 2) Simulate abnormal conditions to demonstrate proper function of safety devices.
    - 3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.
2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:
  - a. Re-check I/O points that required corrections during initial test.
  - b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.
5. After 24 Hours of Second Validation Test:
  - a. Re-check I/O points that required corrections during second test.
  - b. Continue validation testing until I/O point is normal on two consecutive tests.
6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. DDC System Response Time Test:

1. Simulate HLC.
  - a. Heavy load shall be an occurrence of 50 percent of total connected binary COV, one-half of which represent an "alarm" condition, and 50 percent of total connected analog COV, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.
2. Initiate 10 successive occurrences of HLC and measure response time to typical alarms and status changes.
3. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.
4. Purpose of test is to demonstrate DDC system, as follows:
  - a. Reaction to COV and alarm conditions during HLC.
  - b. Ability to update DDC system database during HLC.
5. Passing test is contingent on the following:
  - a. Alarm reporting at printer beginning no more than two seconds after the initiation (time zero) of HLC.
  - b. All alarms, both binary and analog, are reported and printed; none are lost.
  - c. Compliance with response times specified.
6. Prepare and submit a report documenting HLC tested and results of test including time stamp and print out of all alarms.

H. DDC System Network Bandwidth Test:

1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.
2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

**3.24 DDC SYSTEM WIRELESS NETWORK VERIFICATION**

- A. DDC system Installer shall design wireless DDC system networks to comply with performance requirements indicated.
- B. Installer shall verify wireless network performance through field testing and shall document results in a field test report.
- C. Testing and verification of all wireless devices shall include, but not be limited to, the following:
  - 1. Speed.
  - 2. Online status.
  - 3. Signal strength.

**3.25 FINAL REVIEW**

- A. Submit written request to Architect and Construction Manager when DDC system is ready for final review. Written request shall state the following:
  - 1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
  - 2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
  - 3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
  - 4. DDC system is complete and ready for final review.
- B. Review by Architect and Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.
- C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.
- D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.
- E. Prepare and submit closeout submittals when no deficiencies are reported.
- F. A part of DDC system final review shall include a demonstration to parties participating in final review.
  - 1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
  - 2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
  - 3. Demonstration shall include, but not be limited to, the following:
    - a. Accuracy and calibration of 20 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
    - b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 20 I/O points

- shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.
- c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
  - d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
  - e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
  - f. Trends, summaries, logs and reports set-up for Project.
  - g. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.
  - h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.
  - i. Software's ability to edit control programs off-line.
  - j. Data entry to show Project-specific customizing capability including parameter changes.
  - k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
  - l. Execution of digital and analog commands in graphic mode.
  - m. Spreadsheet and curve plot software and its integration with database.
  - n. Online user guide and help functions.
  - o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
  - p. System speed of response compared to requirements indicated.
  - q. For Each Controller:
    - 1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
    - 2) Operator Interface: Ability to connect directly to each type of digital controller with a portable workstation and mobile device. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
    - 3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
    - 4) Electric Power: Ability to disconnect any controller safely from its power source.
    - 5) Wiring Labels: Match control drawings.
    - 6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.
    - 7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.
  - r. For Each Operator Workstation:
    - 1) I/O points lists agree with naming conventions.
    - 2) Graphics are complete.
    - 3) UPS unit, if applicable, operates.
  - s. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Requirements must be met even if only one manufacturer's equipment is installed.
    - 1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.

- 2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
- 3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated.
- 4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
- 5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
- 6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
- 7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
- 8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
- 9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
- 10) Device and Network Management:
  - a) Display of network device status.
  - b) Silencing devices transmitting erroneous data.
  - c) Time synchronization.
  - d) Remote device re-initialization.
  - e) Backup and restore network device programming and master database(s).
  - f) Configuration management of routers.

### 3.26 EXTENDED OPERATION TEST

- A. Extended operation test is intended to simulate normal operation of DDC system by Owner.
- B. Operate DDC system for an operating period of **14** consecutive calendar days following Substantial Completion. Coordinate exact start date of testing with Owner.
- C. Provide an operator familiar with DDC system installed to man an operator workstation during eight hours of each normal business day occurring during operating period.
- D. During operating period, DDC system shall demonstrate correct operation and accuracy of monitored and controlled points as well as operation capabilities of sequences, logs, trends, reports, specialized control algorithms, diagnostics, and other software indicated.
  1. Correct defects of hardware and software when it occurs.
- E. Definition of Failures and Downtime during Operating Period:
  1. Failed I/O point constituting downtime is an I/O point failing to perform its intended function consistently and a point physically failed due to hardware and software.
  2. Downtime is when any I/O point in DDC system is unable to fulfill its' required function.
  3. Downtime shall be calculated as elapsed time between a detected point failure as confirmed by an operator and time point is restored to service.
  4. Maximum time interval allowed between DDC system detection of failure occurrence and operator confirmation shall be 0.5 hours.
  5. Downtime shall be logged in hours to nearest 0.1 hour.
  6. Power outages shall not count as downtime, but shall suspend test hours unless systems are provided with UPS and served through a backup power source.

7. Hardware or software failures caused by power outages shall count as downtime.
- F. During operating period, log downtime and operational problems are encountered.
1. Identify source of problem.
  2. Provide written description of corrective action taken.
  3. Record duration of downtime.
  4. Maintain log showing the following:
    - a. Time of occurrence.
    - b. Description of each occurrence and pertinent written comments for reviewer to understand scope and extent of occurrence.
    - c. Downtime for each failed I/O point.
    - d. Running total of downtime and total time of I/O point after each problem has been restored.
  5. Log shall be available to Owner for review at any time.
- G. For DDC system to pass extended operation test, total downtime shall not exceed 2 percent of total point-hours during operating period.
1. Failure to comply with minimum requirements of passing at end of operating period indicated shall require that operating period be extended one consecutive day at a time until DDC system passes requirement.
- H. Evaluation of DDC system passing test shall be based on the following calculation:
1. Downtime shall be counted on a point-hour basis where total number of DDC system point-hours is equal to total number of I/O points in DDC system multiplied by total number of hours during operating period.
  2. One point-hour of downtime is one I/O point down for one hour. Three points down for five hours is a total of 15 point-hours of downtime. Four points down for one-half hour is 2 point-hours of downtime.
  3. Example Calculation: Maximum allowable downtime for 30-day test when DDC system has 1000 total I/O points (combined analog and binary) and has passing score of 1 percent downtime is computed by 30 days x 24 h/day x 1000 points x 1 percent equals 7200 point-hours of maximum allowable downtime.
- I. Prepare test and inspection reports.

### **3.27 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### **3.28 MAINTENANCE SERVICE**

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by DDC system manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### **3.29 SOFTWARE SERVICE AGREEMENT**

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two year(s).

- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within **two** year(s) from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least **30** days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

### 3.30 DEMONSTRATION

- A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.
- B. Extent of Training:
  - 1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
  - 2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
  - 3. Minimum Training Requirements:
    - a. Provide not less than 10 days of training total.
    - b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
    - c. Total days of training shall be broken into not more than four separate training classes.
    - d. Each training class shall be not less than two consecutive day(s).
- C. Training Schedule:
  - 1. Schedule training with Owner **20** business days before expected Substantial Completion.
  - 2. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions.
  - 3. Provide staggered training schedule as requested by Owner.
- D. Training Attendee List and Sign-in Sheet:
  - 1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
  - 2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
  - 3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
  - 4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
  - 5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.
- E. Training Attendee Headcount:
  - 1. Plan in advance of training for five attendees.
  - 2. Make allowance for Owner to add up to five attendee(s) at time of training.
  - 3. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.
- F. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
  2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
  3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.
- G. Instructor Requirements:
1. One or multiple qualified instructors, as required, to provide training.
  2. Instructors shall have not less than five years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.
- H. Organization of Training Sessions:
1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:
    - a. Daily operators.
    - b. Advanced operators.
    - c. System managers and administrators.
  2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.
- I. Training Outline:
1. Submit training outline for Owner review at least 10 business day before scheduling training.
  2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.
- J. On-Site Training:
1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
  2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
  3. Provide as much of training located on-site as deemed feasible and practical by Owner.
  4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
  5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.
- K. Off-Site Training:
1. Provide conditioned training rooms and workspace with ample tables desks or tables, chairs, power and data connectivity for each attendee.
  2. Provide capability to remotely access to Project DDC system for use in training.
  3. Provide a workstation for use by each attendee.
- L. Training Content for Daily Operators:
1. Basic operation of system.
  2. Understanding DDC system architecture and configuration.
  3. Understanding each unique product type installed including performance and service requirements for each.

4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
  5. Operating operator workstations, printers and other peripherals.
  6. Logging on and off system.
  7. Accessing graphics, reports and alarms.
  8. Adjusting and changing set points and time schedules.
  9. Recognizing DDC system malfunctions.
  10. Understanding content of operation and maintenance manuals including control drawings.
  11. Understanding physical location and placement of DDC controllers and I/O hardware.
  12. Accessing data from DDC controllers.
  13. Operating portable operator workstations.
  14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
  15. Running each specified report and log.
  16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
  17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
  18. Executing digital and analog commands in graphic mode.
  19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
  20. Demonstrating DDC system performance through trend logs and command tracing.
  21. Demonstrating scan, update, and alarm responsiveness.
  22. Demonstrating spreadsheet and curve plot software, and its integration with database.
  23. Demonstrating on-line user guide, and help function and mail facility.
  24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
  25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:
    - a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
    - b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.
    - c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
    - d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
    - e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
    - f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
    - g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.
  26. <Insert requirement>.
- M. Training Content for Advanced Operators:
1. Making and changing workstation graphics.
  2. Creating, deleting and modifying alarms including annunciation and routing.



3. Creating, deleting and modifying point trend logs including graphing and printing on an ad-hoc basis and operator-defined time intervals.
  4. Creating, deleting and modifying reports.
  5. Creating, deleting and modifying points.
  6. Creating, deleting and modifying programming including ability to edit control programs off-line.
  7. Creating, deleting and modifying system graphics and other types of displays.
  8. Adding DDC controllers and other network communication devices such as gateways and routers.
  9. Adding operator workstations.
  10. Performing DDC system checkout and diagnostic procedures.
  11. Performing DDC controllers operation and maintenance procedures.
  12. Performing operator workstation operation and maintenance procedures.
  13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
  14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.
  15. Adjusting, calibrating and replacing DDC system components.
  16. <Insert requirement>.
- N. Training Content for System Managers and Administrators:
1. DDC system software maintenance and backups.
  2. Uploading, downloading and off-line archiving of all DDC system software and databases.
  3. Interface with Project-specific, third-party operator software.
  4. Understanding password and security procedures.
  5. Adding new operators and making modifications to existing operators.
  6. Operator password assignments and modification.
  7. Operator authority assignment and modification.
  8. Workstation data segregation and modification.
  9. <Insert requirement>.
- O. Video of Training Sessions:
1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
  2. Stamp each recording file with training session number, session name and date.
  3. Provide Owner with two copies of digital files on DVDs or flash drives for later reference and for use in future training.
  4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

**END OF SECTION 230923**

**SECTION 230923.12****CONTROL DAMPERS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section includes the following types of control dampers and actuators for DDC systems:
  - 1. Rectangular control dampers.
  - 2. Round control dampers.
  - 3. General control-damper actuator requirements.
  - 4. Pneumatic actuators.
  - 5. Electric and electronic actuators.
- B. Related Requirements:
  - 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
  - 2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.12.

**1.03 DEFINITIONS**

- A. DDC: Direct-digital control.
- B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

**1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including the following:
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 3. Product description with complete technical data, performance curves, and product specification sheets.
  - 4. Installation instructions, including factors affecting performance.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.

4. Include diagrams for air and process signal tubing.
5. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control dampers and actuators, including the following.
  - a. Flow at project design and minimum flow conditions.
  - b. Face velocity at project design and minimum airflow conditions.
  - c. Pressure drop across damper at project design and minimum airflow conditions.
  - d. AMCA 500D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
  - e. Maximum close-off pressure.
  - f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
  - g. Torque required at worst case condition for sizing actuator.
  - h. Actuator selection indicating torque provided.

### 1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Product installation location shown in relationship to room, duct, and equipment.
  2. Size and location of wall access panels for control dampers and actuators installed behind walls.
  3. Size and location of ceiling access panels for control dampers and actuators installed above inaccessible ceilings.

### 1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.
- C. Delegated Design: Engage a qualified professional, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.
- D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.
- E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.
- F. Environmental Conditions:
1. Provide electric control-damper actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control-damper actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.

- a. Hazardous Locations: Explosion-proof rating for condition.

G. Selection Criteria:

1. Control dampers shall be suitable for operation at following conditions:
  - a. Supply Air:
  - b. Return Air:
  - c. Outdoor Air:
  - d. Mixed Air:
  - e. Exhaust Air:
2. Fail positions unless otherwise indicated:
  - a. Supply Air: Open.
  - b. Return Air: Open.
  - c. Outdoor Air: Close.
  - d. Mixed Air: Open.
  - e. Exhaust Air: Open.
3. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
4. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.
5. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.
6. Pneumatic, two-position control dampers shall provide a smooth opening and closing characteristic slow enough to avoid excessive pressure. Dampers with pneumatic actuators shall have an adjustable opening time (valve full closed to full open) and an adjustable closing time (valve full open to full closed) ranging from zero to 10 seconds. Opening and closing times shall be independently adjustable.
7. Control-damper, pneumatic-control signal shall not exceed 200 feet. For longer distances, provide an electric/electronic control signal to the damper and an electric solenoid valve or electro-pneumatic transducer at the damper to convert the control signal to pneumatic.

## 2.02 RECTANGULAR CONTROL DAMPERS

A. General Requirements:

1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.

B. Rectangular Dampers with Aluminum Airfoil Blades:

1. Performance:
  - a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
  - b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 6000 fpm.
  - d. Temperature: Minus 40 to plus 185 deg F.
  - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
  - f. Damper shall have AMCA seal for both air leakage and air performance.
2. Construction:
  - a. Frame:

- 1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.07 inch thick.
- 2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch
- 3) Width not less than 5 inches
- b. Blades:
  - 1) Hollow, airfoil, extruded aluminum.
  - 2) Parallel or opposed blade configuration as required by application.
  - 3) Material: ASTM B211, Alloy 6063 T5 aluminum, 0.07 inch thick.
  - 4) Width not to exceed 6 inches
  - 5) Length as required by close-off pressure, not to exceed 48 inches
- c. Seals:
  - 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
  - 2) Jams: Stainless steel, compression type.
- d. Axles: 0.5-inch- diameter plated steel, mechanically attached to blades.
- e. Bearings:
  - 1) Molded synthetic or stainless-steel sleeve mounted in frame.
  - 2) Where blade axles are installed in vertical position, provide thrust bearings.
- f. Linkage:
  - 1) Concealed in frame.
  - 2) Constructed of aluminum and plated steel.
  - 3) Hardware: Stainless steel.
- g. Transition:
  - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
  - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
  - 3) Damper size and sleeve shall be connection size plus 2 inches
  - 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
  - 5) Sleeve material shall match adjacent duct.
- h. Additional Corrosion Protection for Corrosive Environments:
  - 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
  - 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.
3. Airflow Measurement:
  - a. Where indicated, provide damper assembly with integral airflow monitoring.
  - b. Zero- to 10-V dc or 4- to 20-mA scaled output signal for remote monitoring of actual airflow.
  - c. Accuracy shall be within 5 percent of the actual flow rate between the range of minimum and design airflow. For applications with a large variation in range between the minimum and design airflow, configure the damper sections and flow measurement assembly as required to comply with the stated accuracy over the entire modulating range.
  - d. Provide a straightening device as part of the flow measurement assembly to achieve the specified accuracy with configuration indicated.
  - e. Suitable for operation in untreated and unfiltered air.
  - f. Provide temperature and altitude compensation and correction to maintain accuracy over temperature range encountered at site altitude.
  - g. Provide automatic zeroing feature.
4. Airflow Control:
  - a. Where indicated, provide damper assembly with integral airflow measurement and control.

- b. A factory-furnished and -calibrated controller shall be programmed, in nonvolatile EPROM, with application-specific airflow set point and range.
- c. The controller and actuator shall communicate to control the desired airflow.
- d. The controller shall receive a zero- to 10-V dc input signal and report a zero- to 20-mA output signal that is proportional to the airflow.
- e. Airflow measurement and control range shall be suitable for operation between 150 to 2000 fpm
- f. Ambient Operating Temperature Range: Minus 40 to plus 140 deg F
- g. Ambient Operating Humidity Range: 5 to 95 percent relative humidity, non-condensing.
- h. Provide unit with control transformer rated for not less than 85 VA. Provide transformer with primary and secondary protection and primary disconnecting means. Coordinate requirements with field power connection.
- i. Provide screw terminals for interface to field wiring.
- j. Factory mount electronics within a NEMA 250, Type 1 painted steel enclosure.

C. Rectangular Dampers with Steel Airfoil Blades:

- 1. Performance:
  - a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
  - b. Pressure Drop: 0.06-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 6000 fpm
  - d. Temperature: Minus 40 to plus 185 deg F.
  - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
  - f. Damper shall have AMCA seal for both air leakage and air performance.
- 2. Construction:
  - a. Frame:
    - 1) Material: ASTM A653/A653M galvanized-steel profiles, 0.06 inch thick.
    - 2) Hat-shaped channel with integral flanges. Mating face shall be a minimum of 1 inch.
    - 3) Width not less than 5 inches.
  - b. Blades:
    - 1) Hollow, airfoil, galvanized steel.
    - 2) Parallel or opposed blade configuration as required by application.
    - 3) Material: ASTM A653/A653M galvanized steel, 0.05 inch thick.
    - 4) Width not to exceed 6 inches.
    - 5) Length as required by close-off pressure, not to exceed 48 inches
  - c. Seals:
    - 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
    - 2) Jambs: Stainless steel, compression type.
  - d. Axles: 0.5-inch- diameter plated steel, mechanically attached to blades.
  - e. Bearings:
    - 1) Stainless steel mounted in frame.
    - 2) Where blade axles are installed in vertical position, provide thrust bearings.
  - f. Linkage:
    - 1) Concealed in frame.
    - 2) Constructed of aluminum and plated steel.
    - 3) Hardware: Stainless steel.
  - g. Transition:
    - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
    - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.

- 3) Damper size and sleeve shall be connection size plus 2 inches.
  - 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
  - 5) Sleeve material shall match adjacent duct.
  - h. Additional Corrosion Protection for Corrosive Environments:
    - 1) Provide epoxy finish for surfaces in contact with airstream.
    - 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.
- D. Industrial-Duty Rectangular Dampers with Steel Airfoil Blades:
1. Performance:
    - a. Leakage: Leakage shall not exceed 3 cfm/sq. ft. (15.2 L/s per sq. m) against 1-in. wg (250-Pa) differential static pressure.
    - b. Pressure Drop: 0.06-in. wg (15 Pa) at 2000 fpm (10 m/s) across a 48-by-48-inch (1200-by-1200-mm) damper when tested according to AMCA 500-D, figure 5.3.
    - c. Velocity: Up to 4000 fpm (20 m/s).
    - d. Temperature: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
    - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length, minimum 10-in. wg (2500 Pa).
  2. Construction:
    - a. Frame:
      - 1) Material: Galvanized steel, 0.11 inch (2.8 mm) thick.
      - 2) C-shaped channel. Mating face shall be a minimum of 1 inch (25 mm).
      - 3) Width not less than 3 inches
    - b. Blades:
      - 1) Hollow, airfoil, galvanized steel.
      - 2) Parallel or opposed blade configuration as required by application.
      - 3) Material: Galvanized steel, 0.06 inch (1.6 mm) thick.
      - 4) Width not to exceed 6 inches.
      - 5) Length not to exceed 48 inches.
    - c. Seals:
      - 1) Blades: Replaceable, mechanically attached EPDM or extruded silicone.
      - 2) Jambs: Stainless steel, double compression type.
    - d. Axles: 0.5- or 0.75-inch- diameter plated steel, mechanically attached to blades and continuous from end to end.
    - e. Bearings:
      - 1) Stainless-steel sleeve type mounted in frame.
      - 2) Where blade axles are installed in vertical position, provide thrust bearings.
    - f. Linkage:
      - 1) Face linkage exposed to airstream.
      - 2) Constructed of plated steel.
      - 3) Hardware: Stainless steel.
- E. Rectangular Dampers with Aluminum Flat Blades:
1. Performance:
    - a. Leakage: Leakage shall not exceed 3.2 cfm/sq. ft. (16.2 L/s per sq. m) against 1-in. wg (250-Pa) differential static pressure.
    - b. Pressure Drop: 0.07-in. wg (17.5 Pa) at 1500 fpm (7.6 m/s) across a 24-by-24-inch (600-by-600-mm) damper when tested according to AMCA 500-D, figure 5.3.
    - c. Velocity: Up to 2000 fpm (10 m/s).
    - d. Temperature: Minus 50 to plus 250 deg F (Minus 46 to plus 121 deg C).
    - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length, not to exceed 3-in. wg (750 Pa).
    - f. Damper shall have AMCA seal for both air leakage and air performance.
  2. Construction:

- a. Frame:
  - 1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.12 inch (3.2 mm) thick.
  - 2) Hat-shaped channel.
  - 3) Width not less than 5 inches (125 mm).
- b. Blades:
  - 1) Flat blades of extruded aluminum.
  - 2) Parallel or opposed blade configuration as required by application.
  - 3) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.12 inch (3.2 mm) thick.
  - 4) Width not to exceed 6 inches (150 mm).
  - 5) Length as required by close-off pressure, not to exceed 48 inches (1200 mm).
- c. Seals:
  - 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl or plastic composite.
  - 2) Jambs: Stainless steel, compression type.
- d. Axles: 0.5-inch- (13-mm-)diameter plated steel, mechanically attached to blades.
- e. Bearings:
  - 1) Molded-synthetic sleeve, mounted in frame.
  - 2) Where blade axles are installed in vertical position, provide thrust bearings.
- f. Linkage:
  - 1) Concealed in frame.
  - 2) Constructed of plated steel.
  - 3) Hardware: Stainless steel.
- g. Transition:
  - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
  - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
  - 3) Damper size and sleeve shall be connection size plus 2 inches (50 mm).
  - 4) Sleeve length shall be not less than 12 inches (300 mm) for dampers without jackshafts and shall be not less than 16 inches (450 mm) for dampers with jackshafts.
  - 5) Sleeve material shall match adjacent duct.
- h. Additional Corrosion Protection for Corrosive Environments:
  - 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch (0.018 mm) thick.
  - 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

F. Rectangular Dampers with Steel Flat Blades:

- 1. Performance:
  - a. Leakage: Leakage shall not exceed 4.8 cfm/sq. ft. (24.3 L/s per sq. m) against 1-in. wg (250-Pa) differential static pressure.
  - b. Pressure Drop: 0.1-in. wg (25 Pa) at 1500 fpm (7.6 m/s) across a 24-by-24-inch (600-by-600-mm) damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 1500 fpm (7.6 m/s).
  - d. Temperature: Minus 25 to plus 180 deg F (Minus 32 to plus 82 deg C).
  - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length, not to exceed 4-in. wg (1000 Pa).
  - f. Damper shall have AMCA seal for both air leakage and air performance.
- 2. Construction:
  - a. Frame:
    - 1) Material: Galvanized steel, 0.06 inch (1.6 mm) thick.



- 2) Hat-shaped channel with integral flanges.
  - 3) Width not less than 5 inches (125 mm).
  - b. Blades:
    - 1) Flat blades with multiple grooves positioned axially for reinforcement.
    - 2) Parallel or opposed blade configuration as required by application.
    - 3) Material: Galvanized steel, 0.06 inch (1.6 mm) thick.
    - 4) Width not to exceed 6 inches (150 mm).
    - 5) Length as required by close-off pressure, not to exceed 48 inches (1200 mm).
  - c. Seals:
    - 1) Blades: Replaceable, mechanically attached, PVC-coated polyester.
    - 2) Jamb: Stainless steel, compression type.
  - d. Axles: 0.5-inch- (13-mm-) diameter plated steel, mechanically attached to blades.
  - e. Bearings:
    - 1) Molded-synthetic sleeve, mounted in frame.
    - 2) Where blade axles are installed in vertical position, provide thrust bearings.
  - f. Linkage:
    - 1) Concealed in frame.
    - 2) Constructed of plated steel.
    - 3) Hardware: Stainless steel.
- G. Insulated Rectangular Dampers:
- 1. Performance:
    - a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. (15.2 L/s per sq. m) against 1-in. wg (250-Pa) differential static pressure and shall not exceed 4.9 cfm/sq. ft. (25 L/s per sq. m) against 4-in. wg (1000-Pa) differential static pressure at minus 40 deg F (minus 40 deg C).
    - b. Pressure Drop: 0.1-in. wg (25 Pa) at 1500 fpm (7.6 m/s) across a 24-by-24-inch (600-by-600-mm) damper when tested according to AMCA 500-D, figure 5.3.
    - c. Velocity: Up to 4000 fpm (20 m/s).
    - d. Temperature: Minus 100 to plus 185 deg F (Minus 73 to plus 85 deg C).
    - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
    - f. Damper shall have AMCA seal for both air leakage and air performance.
  - 2. Construction:
    - a. Frame:
      - 1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.08 inch (2.0 mm) thick.
      - 2) C-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch (25 mm).
      - 3) Width not less than 4 inches (100 mm).
      - 4) Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.
      - 5) Damper frame shall be insulated with polystyfoam on four sides.
    - b. Blades:
      - 1) Hollow shaped, extruded aluminum.
      - 2) Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
      - 3) Parallel or opposed blade configuration as required by application.
      - 4) Material: ASTM B211, Alloy 6063 T5 aluminum, 0.08 inch (2.0 mm) thick.
      - 5) Width not to exceed 6 inches (150 mm).
      - 6) Length as required by close-off pressure, not to exceed 48 inches (1200 mm).
    - c. Seals: Blade and frame seals shall be of flexible silicone and secured in an integral slot within the aluminum extrusions.

- d. Axles: 0.44-inch- (11-mm-) diameter plated steel, mechanically attached to blades.
- e. Bearings:
  - 1) Bearings shall be composed of a Celcon inner bearing fixed to axle, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
  - 2) Where blade axles are installed in vertical position, provide thrust bearings.
- f. Linkage:
  - 1) Concealed in frame.
  - 2) Constructed of aluminum and plated steel.
  - 3) Hardware: Stainless steel.
- g. Transition:
  - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
  - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
  - 3) Damper size and sleeve shall be connection size plus 2 inches (50 mm).
  - 4) Sleeve length shall be not less than 12 inches (300 mm) for dampers without jackshafts and shall be not less than 16 inches (450 mm) for dampers with jackshafts.
  - 5) Sleeve material shall match adjacent duct.
- h. Additional Corrosion Protection for Corrosive Environments:
  - 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch (0.018 mm) thick.
  - 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

## 2.03 ROUND CONTROL DAMPERS

### A. Round Dampers, Sleeve Type:

- 1. Performance:
  - a. Leakage: Leakage shall not exceed 0.15 cfm/in. (0.0028 L/s per mm) of perimeter blade at 4-in. wg (1000-Pa) differential static pressure.
  - b. Pressure Drop: 0.02-in. wg (5 Pa) at 1500 fpm (7.6 m/s) across a 12-inch (300-mm) damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 4000 fpm (20 m/s).
  - d. Temperature: Minus 25 to plus 200 deg F (Minus 32 to plus 93 deg C).
  - e. Pressure Rating: 8-in. wg (2000 Pa) for sizes through 12 inches (300 mm), 6-in. wg (1500 Pa) for larger sizes.
- 2. Construction:
  - a. Frame:
    - 1) Material: Galvanized steel, 0.04 in (1.0 mm) thick.
    - 2) Outward rolled stiffener beads positioned approximately 1 inch (25 mm) inboard of each end.
    - 3) Sleeve-type connection for mating to adjacent ductwork.
    - 4) Size Range: 4 to 24 inches (100 to 600 mm).
    - 5) Length not less than 7 inches (175 mm).
    - 6) Provide 2-inch (50-mm) sheet metal stand-off for mounting actuator.
  - b. Blade: Double-thickness circular flat blades sandwiched together and constructed of galvanized steel.
  - c. Blade Seal: Polyethylene foam seal sandwiched between two sides of blades and fully encompassing blade edge.
  - d. Axle: 0.5-inch- (13-mm-) diameter stainless steel, mechanically attached to blade.
  - e. Bearings: Stainless-steel sleeve pressed into frame.

### B. Round Dampers, Flanged Type:

- 1. Performance:

- a. Leakage: Leakage shall not exceed 0.15 cfm/in. (0.0028 L/s per mm) of perimeter blade at 4-in. wg (1000-Pa) differential static pressure.
  - b. Pressure Drop: 0.03-in. wg (7.5 Pa) at 1500 fpm (7.6 m/s) across a 12-inch (300-mm) damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 4000 fpm (20 m/s).
  - d. Temperature: Minus 25 to plus 250 deg F (Minus 32 to plus 121 deg C).
  - e. Pressure Rating: 8-in. wg (2000 Pa) for sizes through 36 inches (900 mm) in diameter, 6-in. wg (1500 Pa) for larger sizes.
2. Construction:
- a. Frame:
    - 1) Size Range: 4 to 60 inches (100 to 1500 mm).
    - 2) Material: Galvanized steel.
      - a) Sizes through 24 Inches (600 mm) in Diameter: 0.15 inch (4 mm) thick.
      - b) Sizes 26 through 48 Inches (650 through 1200 mm) in Diameter: 0.25 inch (6 mm) thick.
      - c) Larger Sizes: 0.31 inch (8 mm) thick.
    - 3) Flanges:
      - a) Outward rolled with bolt holes on each end of frame for mating to adjacent ductwork.
      - b) Face: Not less than 1.25 inch (31 mm) for damper sizes through 12 inches (300 mm) in diameter, 1.5 inch (38 mm) for damper sizes 14 through 24 inches (350 through 600 mm) in diameter, and 2 inches (50 mm) for larger sizes.
    - 4) Length (Flange Face to Face): Not less than 8 inches (200 mm).
    - 5) Provide 3-inch (75-mm) sheet metal stand-off for mounting actuator.
  - b. Blade: Reinforced circular flat blade constructed of galvanized steel.
    - 1) Sizes through 24 Inches (600 mm): 0.15 inch (4 mm) thick.
    - 2) Sizes 26 through 48 Inches (650 through 1200 mm): 0.19 inch (5 mm) thick.
    - 3) Larger Sizes: 0.25 inch (6 mm) thick.
  - c. Blade Stop: Full circumference, located in airstream, minimum 0.5 by 0.25 inch (13 by 6 mm) galvanized-steel bar.
  - d. Blade Seal: Neoprene, mechanically attached to blade and fully encompassing blade edge.
  - e. Axle: Plated steel, mechanically attached to blade.
    - 1) Sizes through 14 Inches (350 mm): 0.5 inch (13 mm) in diameter.
    - 2) Sizes 16 through 42 Inches (400 through 1050 mm): 0.75 inch (19 mm) in diameter.
    - 3) Larger Sizes: 1 inch (25 mm) in diameter.
  - f. Bearings: Stainless-steel sleeve pressed into frame.

#### 2.04 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

- A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.
- B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
- C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
- D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

- E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.
- F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.
- G. Provide mounting hardware and linkages for connecting actuator to damper.
- H. Select actuators to fail in desired position in the event of a power failure.

## **2.05 ELECTRIC AND ELECTRONIC ACTUATORS**

- A. Type: Motor operated, with or without gears, electric and electronic.
- B. Voltage:
  - 1. See Drawings.
  - 2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
  - 3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.
- C. Construction:
  - 1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
  - 2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
  - 3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
- D. Field Adjustment:
  - 1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
  - 2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.
- E. Two-Position Actuators: Single direction, spring return or reversing type.
- F. Modulating Actuators:
  - 1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
  - 2. Control Input Signal:
    - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
    - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero-to 10 or 2-to 10-V dc and 4- to 20-mA signals.
    - c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to a pulse duration (length) of signal from a dry-contact closure, triac sink or source controller.
    - d. Programmable Multi-Function:
      - 1) Control input, position feedback, and running time shall be factory or field programmable.
      - 2) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.

- 3) Service data, including at a minimum, number of hours powered and number of hours in motion.

G. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of position.
2. Equip modulating actuators with a position feedback through current signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

H. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

I. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

J. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

K. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

L. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with a heater and controller where required by application.

M. Stroke Time:

1. Operate damper from fully closed to fully open within 60 seconds.
2. Operate damper from fully open to fully closed within 60seconds.
3. Move damper to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

N. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

**PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION, GENERAL**

- A. Furnish and install products required to satisfy most stringent requirements indicated.
- B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.
- C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Seal penetrations made in fire-rated and acoustically rated assemblies.
- E. Fastening Hardware:
  - 1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- G. Corrosive Environments:
  - 1. Use products that are suitable for environment to which they will be subjected.
  - 2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:
    - a. Laboratory exhaust airstreams.
    - b. Process exhaust airstreams.
  - 3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
  - 4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
  - 5. Where actuators are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

**3.03 ELECTRIC POWER**

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

**3.04 CONTROL DAMPERS**

- A. Install smooth transitions, not exceeding 15 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
- B. Clearance:
  - 1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
  - 2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.
- C. Service Access:
  - 1. Dampers and actuators shall be accessible for visual inspection and service.
  - 2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."
- D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
- E. Attach actuator(s) to damper drive shaft.
- F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

**3.05 CONNECTIONS**

- A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

**3.06 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with damper identification on damper.

**3.07 CHECKOUT PROCEDURES**

- A. Control-Damper Checkout:
1. Check installed products before continuity tests, leak tests, and calibration.
  2. Check dampers for proper location and accessibility.
  3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
  4. For pneumatic products, verify air supply for each product is properly installed.
  5. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
  6. Verify that control dampers are installed correctly for flow direction.
  7. Verify that proper blade alignment, either parallel or opposed, has been provided.
  8. Verify that damper frame attachment is properly secured and sealed.
  9. Verify that damper actuator and linkage attachment are secure.
  10. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
  11. Verify that damper blade travel is unobstructed.

**3.08 ADJUSTMENT, CALIBRATION, AND TESTING:**

- A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.
- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
- D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

**END OF SECTION 230923.12**



**SECTION 230923.23****PRESSURE INSTRUMENTS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Air-pressure sensors.
  - 2. Air-pressure switches.
  - 3. Air-pressure transmitters.
- B. Related Requirements:
  - 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
  - 2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.23.

**1.03 DEFINITIONS**

- A. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a control, asset management, safety, or other system using any control platform.

**1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including the following:
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 3. Product description with complete technical data, performance curves, and product specification sheets.
  - 4. Installation instructions, including factors affecting performance.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

#### **1.05 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Product installation location shown in relationship to room, duct, pipe, and equipment.
  2. Wall-mounted instruments located in finished space, showing relationship to light switches, fire alarm devices, and other installed devices.
  3. Size and location of wall access panels for instruments installed behind walls.
  4. Size and location of ceiling access panels for instruments installed in accessible ceilings.
- B. Product Certificates: For each product requiring a certificate.
- C. Source quality-control reports.
- D. Field quality-control reports.

#### **1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

### **PART 2 - PRODUCTS**

#### **2.01 PERFORMANCE REQUIREMENTS**

- A. Environmental Conditions:
  1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
    - a. If instrument alone cannot comply with requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated filtered, and ventilated as required by instrument and application.
  2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument-installed location shall dictate following NEMA 250 enclosure requirements:
    - a. Outdoors, Protected: Type 3
    - b. Outdoors, Unprotected: Type 4X
    - c. Indoors, Heated with Filtered Ventilation: Type 1
    - d. Indoors, Heated with Nonfiltered Ventilation: Type 2
    - e. Indoors, Heated and Air-Conditioned: Type 1
    - f. Mechanical Equipment Rooms:

#### **2.02 AIR-PRESSURE SENSORS**

- A. Duct Insertion Static Pressure Sensor:
  1. Insertion length shall be at 4 inches (100 mm)
  2. Sensor with four radial holes of 0.04-inch (1-mm) diameter.
  3. Brass or stainless-steel construction.

4. Sensor with threaded end support, sealing washers and nuts.
  5. Connection: NPS 1/4 (DN 6) compression fitting.
  6. Suitable for flat oval, rectangular, and round duct configurations.
- B. Duct Insertion Static Pressure Sensor:
1. Sensor probe with two opposing orifices designed to reduce error-associated air velocity.
  2. Sensor insertion length shall be 4 inches (100 mm) or 8 inches (200 mm).
  3. Construct sensor of 6061-T6 aluminum alloy or Type 304 stainless steel.
  4. Connection: Threaded, NPS 1/8 (DN 6) swivel fitting for connection to copper tubing or NPS 1/4 (DN 10) barbed fitting for connection to polyethylene tubing.
  5. Sensor probe attached to a mounting flange with neoprene gasket and two holes for fasteners.
  6. Mounting flange shall suitable for flat oval, rectangular, and round duct configurations.
  7. Pressure Rating: 10 psig (69 kPa).
- C. Duct Traverse Static Pressure Sensor:
1. Sensor shall traverse the duct cross section and have at least one pickup point every 6 inches (150mm) along length of sensor.
  2. Construct sensor of 18-gage Type T6063-T5 extruded and anodized aluminum.
  3. Sensor supported with threaded rod, sealing washer, and nut at one end and a mounting plate with gasket at other end.
  4. Mounting plate with threaded, NPS 3/8 (DN 12) compression fitting for connection to tubing.
  5. Accuracy within 1 percent of actual operating static pressure.
  6. Dual offset static sensor design shall provide accurate sensing of duct static pressure in the presence of turbulent and rotational airflows with a maximum 30 degree yaw and pitch.
  7. Suitable for velocities of 100 to 10000 fpm (0.51 to 51 m/s) and temperatures of up to 200 deg F (93 deg C).
  8. Sensor air resistance shall be less than 0.1 times the velocity pressure at probe-operating velocity.
  9. Suitable for flat oval, rectangular, and round duct configurations.
- D. Outdoor Static Pressure Sensor:
1. Provides average outdoor pressure signal.
  2. Sensor with no moving parts.
  3. Kit includes sensor, vinyl tubing mounting hardware.
- E. Outdoor Static Pressure Sensor:
1. Provides average outdoor pressure signal.
  2. Sensor with no moving parts.
  3. NEMA 250, Type 4X enclosure.
  4. Pressure Connection: Brass barbed fitting for NPS 1/4 (DN 10) tubing.
  5. Conduit fitting around pressure fitting for sensor support and protection to pressure connection.
- F. Outdoor Static Pressure Sensor:
1. Sensor with no moving parts.
  2. Operation not affected and impaired by rain and snow.
  3. Sensing plates constructed of 0.1406-inch (3.6-mm) Type 316 stainless steel.
  4. Accuracy within:
    - a. 1 percent of the actual outdoor atmospheric pressure when subjected to varying horizontal radial wind velocities up to 40 mph.
    - b. 2 percent of the actual outdoor atmospheric pressure while subjected to varying radial wind velocities up to 40 mph with approach angles up to 30 degrees to horizontal.

- c. 3 percent of the actual outdoor atmospheric pressure while subjected to varying radial wind velocities up to 40 mph with approach angles up to 60 degrees to horizontal.
  - d. Threaded, NPS 2 (DN 50) connection.
- G. Space Static Pressure Sensor for Wall Mounting:
- 1. 100-micron filter mounted in stainless-steel wall plate senses static pressure.
  - 2. Wall plate provided with gasket and screws, and sized to fit standard single-gang electrical box.
  - 3. Back of sensor plate fitted with brass barbed fitting for tubing connection.
- H. Space Static Pressure Sensor for Wall Mounting:
- 1. White ABS plastic wall plate with integral sensing port to sense static pressure.
  - 2. Wall plate provided with matching colored screws and sized to fit standard single-gang electrical box.
  - 3. Back of sensor plate fitted with brass union fitting for tubing connection.
  - 4. Pressure rating: 10 psig (69kPa).
- I. Space Static Pressure Sensor for Wall Mounting:
- 1. Aluminum wall plate with perforated center arranged to sense space static pressure. Exposed surfaces are provided with brush finish.
  - 2. Wall plate provided with screws and sized to fit standard single-gang electrical box.
  - 3. Back of sensor plate fitted with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 0.125-inch (3-mm) fitting for tubing connection.
  - 4. Performance: Within 1 percent of actual room static pressure in vicinity of sensor while being subjected to an air velocity of 1000 fpm (5.1 m/s) from a 360-degree radial source.
- J. Space Static Pressure Sensor for Recessed Ceiling Mounting:
- 1. Aluminum round plate with perforated center arranged to sense space static pressure. Exposed surfaces provided with brush finish.
  - 2. Sensor intended for flush mount on face of ceiling with pressure chamber recessed in ceiling plenum.
  - 3. Back of sensor plate fitted with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 0.125-inch (3-mm) fitting for concealed tubing connection.
  - 4. Performance: Within 1 percent of actual room static pressure in vicinity of sensor while being subjected to an air velocity of 1000 fpm (5.1 m/s) from a 360-degree radial source.
- K. Space Static Pressure Sensor for Exposed or Suspended Mounting:
- 1. Performance: Within 1 percent of actual room static pressure in vicinity of sensor while being subjected to an air velocity of 1000 fpm (5.1 m/s) from a 360-degree radial source.
  - 2. Aluminum with perforations arranged to sense space static pressure. Exposed surfaces provided with brush finish.
  - 3. Sensor fitted with multiple sensing ports, pressure impulse suppression chamber, and airflow shielding.
  - 4. Surface-mounted sensor provided with solid mounting plate intended for mount to ceiling with pressure chamber exposed to view.
  - 5. Surface-mounted sensor with 0.125-inch (3-mm) fitting for exposed tubing connection.
  - 6. Suspended sensor intended for pendent mount with pressure chamber exposed to view.
  - 7. Suspended sensor with NPS 1/2 (DN 15) fitting for exposed pipe or tubing connection.

## 2.03 AIR-PRESSURE SWITCHES

- A. Air-Pressure Differential Switch:
- 1. Diaphragm operated to actuate an SPDT snap switch.
    - a. Fan safety shutdown applications: Switch with manual reset.

2. Electrical Connections: Three-screw configuration, including one screw for common operation and two screws for field-selectable normally open or closed operation.
  3. Enclosure Conduit Connection: Knock out or threaded connection.
  4. User Interface: Screw-type set-point adjustment located inside removable enclosure cover.
  5. High and Low Process Connections: Threaded, NPS 1/8 (DN 6).
  6. Enclosure:
    - a. Dry Indoor Installations: NEMA 250, Type 1.
    - b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
    - c. Hazardous Environments: Explosion proof.
  7. Operating Data:
    - a. Electrical Rating: 15 A at 120- to 480-V ac.
    - b. Pressure Limits:
      - 1) Continuous: 45 inches wg (11.2 kPa).
      - 2) Surge: 10 psig (68.9 kPa).
    - c. Temperature Limits: Minus 30 to 180 deg F (Minus 34 to 82 deg C).
    - d. Operating Range: Approximately 2 times set point.
    - e. Repeatability: Within 3 percent.
    - f. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Air-Pressure Differential Switch with Set-Point Indicator:
1. Diaphragm operated to actuate an SPDT snap switch.
  2. Electrical Connections: Three-screw configuration, including one screw for common operation and two screws for field-selectable normally open or closed operation.
  3. Enclosure Conduit Connection: Knock out or threaded connection.
  4. User Interface: Screw-type set-point adjustment with enclosed set-point indicator and scale.
  5. High and Low Process Connections: Threaded, NPS 1/8 (DN 6).
  6. Enclosure:
    - a. Dry Indoor Installations: NEMA 250, Type 1.
    - b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
    - c. Hazardous Environments: Explosion proof.
  7. Operating Data:
    - a. Electrical Rating: 15 A at 120- to 480-V ac.
    - b. Pressure Limits:
      - 1) Continuous: 10 psig (69 kPa).
      - 2) Surge: 25 psig (172 kPa).
    - c. Temperature Limits: Minus 30 to 110 deg F (Minus 34 to 43 deg C).
    - d. Operating Range: Approximately 2 times set point.
    - e. Repeatability: Within 1 percent.
    - f. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Air-Pressure Differential Switch with Dual Scale Adjustable Set Point:
1. Diaphragm operated to actuate an SPDT snap switch.
  2. Electrical Connections: Push-on screw terminals.
  3. Enclosure Conduit Connection: Knock out or threaded connection.
  4. User Interface: Dual scale set-point adjustment knob located inside removable enclosure cover.
  5. High and Low Process Connections: Slip-on tubing connections.
  6. Enclosure:
    - a. Dry Indoor Installations: NEMA 250, Type 13.
  7. Operating Data:
    - a. Electrical Rating: 1.5 A at 250-V ac.
    - b. Pressure Limits: 40 inches wg (10 kPa)

- c. Temperature Limits: Minus 4 to 185 deg F (Minus 20 to 85 deg C).
  - d. Operating Range: Approximately 2 times set point.
- D. Air-Pressure Differential Indicating Switch:
- 1. Combination gage with low- and high-limit switches.
  - 2. Nominal 4-inch- (100-mm-) diameter analog indication with white dial face, graduated black markings, pointer to indicate measured value, and a separate adjustable pointer for each switch set point.
  - 3. Switch zero and set-point **tamperproof** adjustment screws or knobs on the dial face.
  - 4. Each switch used as a safety limit shall have a manual reset button local to switch.
  - 5. Switch Type: Each set point shall have two Form C relays, DPDT.
  - 6. Electrical Connections: Screw terminals.
  - 7. Enclosure Conduit Connection: NPS 3/4 (DN 20) threaded connection.
  - 8. High and Low Process Connections: Threaded, NPS 1/8 (DN 6).
  - 9. Enclosure:
    - a. Dry Indoor Installations: NEMA 250, Type 1.
    - b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
    - c. Hazardous Environments: Explosion proof.
  - 10. Operating Data:
    - a. Electrical Rating: 10 A at 120- to 240-V ac.
    - b. Pressure Limits: 25 psig (172 kPa).
    - c. Temperature Limits: 20 to 120 deg F (Minus 7 to 49 deg C).
    - d. Operating Range: Approximately twice normal operating range unless otherwise required for application.
    - e. Accuracy:
      - 1) 4 percent for ranges through 0.5 in. wg (125 Pa).
      - 2) 2 percent for ranges 1 in. wg (250 Pa) and greater.
    - f. Repeatability: Within 1 percent of full scale.
    - g. Switch Deadband: One pointer width and within 1 percent of full scale for each switch set point.
    - h. Power Supply: **24 or 120**-V ac, 50/60 Hz.
    - i. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.04 AIR-PRESSURE TRANSMITTERS

- A. Air-Pressure Differential Transmitter:
- 1. Performance:
    - a. Range: Approximately 2 times set point.
    - b. Accuracy: Within **0.5** percent of the full-scale range.
    - c. Hysteresis: Within 0.10 percent of full scale.
    - d. Repeatability: Within 0.05 percent of full scale.
    - e. Stability: Within 1 percent of span per year.
    - f. Overpressure: 10 psig (69 kPa).
    - g. Temperature Limits: Zero to 150 deg F (Minus 18 to 66 deg C).
    - h. Compensate Temperature Limits: 40 to 150 deg F (4 to 66 deg C).
    - i. Thermal Effects: 0.033 percent of full scale per degree F.
    - j. Shock and vibration shall not harm the transmitter.
  - 2. Output Signals:
    - a. Analog Current Signal:
      - 1) Two-wire, 4- to 20-mA dc current source.
      - 2) Signal capable of operating into 800-ohm load.
    - b. Analog Voltage Signal:
      - 1) Three wire, zero to **10** V.
      - 2) Minimum Load Resistance: 1000 ohms.

3. Display: Four-digit digital display with minimum 0.4-inch- (10-mm-) high numeric characters.
  4. Operator Interface: Zero and span adjustments located behind cover.
  5. Construction:
    - a. Plastic casing with removable plastic cover.
    - b. Threaded, NPS 1/4 (DN 10) swivel fittings for connection to copper tubing or NPS 3/16 (DN 7) barbed fittings for connection to polyethylene tubing. Fittings on bottom of instrument case.
    - c. Screw terminal block for wire connections.
    - d. Vertical plane mounting.
    - e. NEMA 250, Type 4.
    - f. Provide mounting bracket suitable for installation.
- B. Air Pressure Differential Transmitter:
1. Performance:
    - a. Range: Approximately 2 times set point.
    - b. Accuracy: Within **0.5** percent of the span at reference temperature of 70 deg F (21 deg C).
    - c. Hysteresis: Within 0.02 percent of the span.
    - d. Repeatability: Within 0.05 percent of the calibrated span.
    - e. Stability: Within 0.25 percent of span per year.
    - f. Overpressure: 15 psig (103 kPa).
    - g. Temperature Limits: Minus 20 to 160 deg F (Minus 29 to 71 deg C).
    - h. Compensate Temperature Limits: 35 to 135 deg F (2 to 57 deg C).
    - i. Thermal Effects: 0.015 percent of full scale per degree F.
    - j. Warm-up Time: Within 5 seconds.
    - k. Response Time: **250 ms**.
    - l. Shock and vibration shall not harm the transmitter.
  2. Output Signals:
    - a. Analog Current Signal:
      - 1) Two-wire, 4- to 20-mA dc current source.
      - 2) Signal capable of operating into 1000-ohm load.
    - b. Analog Voltage Signal:
      - 1) Three wire, zero to 6 V.
      - 2) Minimum Load Resistance: 1000 ohms.
  3. Operator Interface:
    - a. Zero and span adjustments within 10 percent of full span.
    - b. Potentiometer adjustments located on face of transmitter.
  4. Construction:
    - a. Type 300 stainless-steel enclosure.
    - b. Swivel fittings for connection to copper tubing or barbed fittings for connection to polyethylene tubing. Fittings on front of instrument enclosure.
    - c. Screw terminal block for wire connections.
    - d. Vertical plane mounting.
    - e. NEMA 250, Type 2.
    - f. Mounting Bracket: Appropriate for installation.
    - g. Reverse wiring protected.
    - h. Calibrate to NIST-traceable standards and provide each transmitter with a certificate of calibration.
- C. Air-Pressure Differential Transmitters for Hazardous Environments:
1. FM Approved for hazardous environments. Intrinsically safe for Classes I, II, and III, Divisions 1 and 2, Groups A through H.
  2. Performance:
    - a. Range: Approximately 2 times set point.

- b. Accuracy: Within 0.5 percent of the span at reference temperature of 70 degrees F.
  - c. Hysteresis: Within 0.02 percent of the span.
  - d. Repeatability: Within 0.05 percent of the calibrated span.
  - e. Stability: Within 0.25 percent of span per year.
  - f. Overpressure: 20 psig (138 kPa).
  - g. Temperature Limits: Minus 20 to 185 deg F (Minus 29 to 85 deg C).
  - h. Compensate Temperature Limits: Zero to 160 deg F (Minus 18 to 71 deg C).
  - i. Thermal Effects: 0.01 percent of full scale per degree F.
  - j. Warm-up Time: Within 5 seconds.
  - k. Response Time: 250 ms.
  - l. Shock and vibration shall not harm the transmitter.
3. Output Signals:
- a. Analog Current Signal:
    - 1) Two-wire, 4- to 20-mA dc current source.
    - 2) Signal capable of operating into 1000-ohm load.
  - b. Analog Voltage Signal:
    - 1) Three wire, zero to 6 V.
    - 2) Minimum Load Resistance: 1000 ohms.
4. Operator Interface:
- a. Zero and span adjustments within 10 percent of full span.
  - b. Potentiometer adjustments located on face of transmitter.
5. Construction:
- a. Type 300 stainless-steel enclosure.
  - b. Swivel fittings for connection to tubing. Fittings on bottom of instrument enclosure.
  - c. Two 1/2-inch (16-mm) trade size conduit connections isolated from electronics.
  - d. Screw terminal block for wire connections.
  - e. Vertical plane mounting.
  - f. NEMA 250, Type 4X.
  - g. Mounting Bracket: Appropriate for installation.
6. Reverse wiring protected.
7. Calibrate to NIST-traceable standards and provide each transmitter with a certificate of calibration.
- D. Air-Pressure Differential Indicating Transmitter:
- 1. Performance:
    - a. Range: Approximately 2 times set point.
    - b. Accuracy Including Hysteresis and Repeatability: Within 1 percent of full scale at 77 deg F (25 deg C).
    - c. Stability: Within 1 percent of full scale per year.
    - d. Overpressure: 10 psig (69 kPa).
    - e. Temperature Limits: 20 to 120 deg F (Minus 7 to 49 deg C).
    - f. Thermal Effects: 0.055 percent of full scale per degree F.
  - 2. Display: Four-digit digital display with minimum 0.4-inch- (10-mm-)high numeric characters.
  - 3. Operator Interface:
    - a. Zero and span adjustments.
    - b. Selectable engineering units.
  - 4. Analog Output Current Signal:
    - a. Two-wire, 4- to 20-mA dc current source.
    - b. Signal capable of operating into a 1200-ohm load.
  - 5. Construction:
    - a. Plastic casing with clear plastic cover.
    - b. Integral fittings for plastic tubing connections on side of instrument case for high- and low-pressure connections.
    - c. Terminal block for wire connections.



- d. Vertical plane mounting.
  - e. NEMA 250, Type 1.
  - f. Nominal 4-inch (100-mm) diameter face.
  - g. Mounting Bracket: Appropriate for installation.
- E. Air-Pressure Differential Indicating Transmitter:
- 1. Performance:
    - a. Range: Approximately 2 times set point.
    - b. Accuracy including hysteresis and repeatability: Within 0.25 percent of full scale.
    - c. Stability: Within 1 percent of full scale per year.
    - d. Overpressure: Varies with range. At least 1.5 times range.
    - e. Temperature Limits: Zero to 140 deg F (Minus 18 to 60 deg C).
    - f. Compensate Temperature Limits: 20 to 120 deg F (Minus 7 to 49 deg C).
    - g. Thermal Effects: 0.02 percent of full scale per degree F.
  - 2. Display: Digital with minimum 0.4-inch- (10-mm-) high numeric characters.
  - 3. Operator Interface: Zero and span adjustments.
  - 4. Analog Output Current Signal:
    - a. Two-wire, 4- to 20-mA dc current source.
    - b. Signal capable of operating into a 1200-ohm load.
  - 5. Construction:
    - a. Plastic casing with removable clear plastic cover.
    - b. Integral barbed fittings for rubber or plastic tubing connections on bottom of instrument case for high- and low-pressure connections.
    - c. Screw terminal block for wire connections.
    - d. Vertical plane mounting.
    - e. NEMA 250, Type 4X.
    - f. Mounting Bracket: Appropriate for installation.
- F. Air-Pressure Differential Indicating Transmitter with Field-Selectable Features:
- 1. Field-Selectable Features:
    - a. Field configurable for pressure and velocity applications through user interface.
    - b. Field selectable from one of three pressure ranges both in SI (metric) and inch-pound (IP) units of measure.
    - c. Select range based on application. Range shall be approximately 2 times set point.
  - 2. Performance:
    - a. Accuracy Including Hysteresis and Repeatability:
      - 1) Within 2 percent for 0.10 in. wg (25 Pa), 1.0 in. wg (250 Pa) and all bi-directional ranges.
      - 2) Within 1 percent for other ranges.
    - b. Stability: Within 1 percent of full scale per year.
    - c. Response Time: Adjustable 0.5- to 15-second time constant with 95 percent response within 1.5 to 45 seconds.
    - d. Overpressure: 1 psig (6.9 kPa) maximum operating; 10 psig (69 kPa) burst pressure.
    - e. Temperature Limits: Zero to 150 deg F (Minus 18 to 66 deg C).
  - 3. Display: Four-digit digital display with minimum 0.4-inch- (10-mm-) high numeric characters.
  - 4. Operator Interface:
    - a. Selectable pressure ranges, where indicated.
    - b. Zero and span adjustments.
    - c. Selectable air velocity mode with square root function.
    - d. Adjustable signal dampening
  - 5. Analog Output Current Signal:
    - a. Two-wire, 4- to 20-mA dc current source.
    - b. Signal capable of operating into a 1200-ohm load.
  - 6. Analog Output Voltage Signal:

- a. Three wire, zero to 10 V.
    - b. Minimum Load Resistance: 1000 ohms.
  7. Construction:
    - a. Plastic casing with removable clear plastic cover.
    - b. NPS 3/16 (DN 7) nominal ID plastic tubing connections on side of instrument case for high- and low-pressure connections.
    - c. NPS 1/2 (DN 15) NPS threaded connection for conduit.
    - d. Terminal block for wire connections.
    - e. Vertical plane mounting.
    - f. NEMA 250, Type 4X.
    - g. Nominal 4-inch- (100-mm-) diameter face.
    - h. Mounting Bracket: Appropriate for installation.
- G. Air-Pressure Differential Transmitter with 0.10 Percent Accuracy and Auto Zero Feature:
  1. Description:
    - a. 4- to 20-mA dc output signal.
    - b. NEMA 250, Type 1 enclosure.
    - c. Construct the assembly so that shock, vibration, and pressure surges of up to 1 psig (6.9 kPa) will neither harm nor affect the accuracy of the transmitter.
    - d. Transmitter with automatic zeroing circuit capable of automatically readjusting the transmitter to zero at predetermined time intervals. The automatic zeroing circuit shall re-zero the transmitter to within 0.1 percent of true zero.
    - e. Performance:
      - 1) Range: Approximately 2 times set point.
      - 2) Calibrated Span: Field adjustable, minus 40 percent of the range.
      - 3) Accuracy: Within 0.10 percent of natural span.
      - 4) Repeatability: Within 0.15 percent of calibrated span.
      - 5) Linearity: Within 0.2 percent of calibrated span.
      - 6) Hysteresis and deadband (combined): Less than 0.2 percent of calibrated span.
    - f. Integral digital display for continuous indication of pressure differential.
- H. Air-Pressure Differential Transmitter with 0.25 Percent Accuracy and Auto Zero Feature:
  1. Description:
    - a. 4- to 20-mA dc output signal.
    - b. NEMA 250, Type 1 enclosure.
    - c. Construct assembly so shock, vibration, and pressure surges of up to 1 psig (6.9 kPa) will neither harm nor affect the accuracy of the transmitter.
    - d. Transmitter with automatic zeroing circuit capable of automatically readjusting the transmitter to zero at predetermined time intervals. The automatic zeroing circuit shall re-zero transmitter to within 0.1 percent of true zero.
    - e. Performance:
      - 1) Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
      - 2) Calibrated Span: Field adjustable, minus 40 percent of the range.
      - 3) Accuracy: Within 0.25 percent of natural span.
      - 4) Repeatability: Within 0.15 percent of calibrated span.
      - 5) Linearity: Within 0.2 percent of calibrated span.
      - 6) Hysteresis and deadband (combined): Less than 0.2 percent of calibrated span.
    - f. Integral digital display for continuous indication of pressure differential.
- I. Air-Pressure Differential Indicating Transmitter, Switch, and Controller:
  1. Description:
    - a. Three-in-one instrument, including digital display, control relay switches, and a transmitter with a current output.

- b. Field configurable for pressure, velocity, and volumetric flow applications through user interface.
  - c. Select instrument range based on application. Range shall be approximately 2 times set point.
2. Performance:
- a. Accuracy Including Hysteresis and Repeatability:
    - 1) Within 1 percent for ranges less than 5 in. wg (1250 Pa).
    - 2) Within 0.5 percent at 77 deg F (25 deg C) for other ranges.
  - b. Stability: Within 1 percent per year.
  - c. Response Time: 250 ms.
  - d. Overpressure: 5 psig (34 kPa) for instrument ranges less than 50 in wg (12.5 kPa) and 9 psig (62 kPa) for 100 in. wg (25 kPa) range.
  - e. Temperature Limits: 32 to 140 deg F (Zero to 60 deg C).
  - f. Thermal Effects: 0.020 percent per degree F.
  - g. Warm-up Period: One hour.
3. Controller Programming through Menu Keys to Access Five Menus:
- a. Security level.
  - b. Pressure, velocity, or flow application.
  - c. Engineering units.
  - d. K-factor for use with flow application.
  - e. Set-point control only; set-point and alarm operation; and alarm operation as high, low, or high/low with manual or automatic reset and delay.
  - f. View high and low readings.
  - g. Digital dampening for smoothing erratic applications.
  - h. Scaling of analog output to fit range and field calibration.
4. Display:
- a. Digital, four-digit display with backlight, with 0.4-inch- (10-mm-) high alphanumeric characters.
  - b. Four indicators; two for set point and two for alarm status.
5. Operator Interface:
- a. Set-point adjustment through keypad on face of instrument.
  - b. Zero and span adjustments accessible through menu.
  - c. Programming through keypad.
6. Analog Output Signal:
- a. Two-wire, 4- to 20-mA dc current source.
  - b. Signal capable of operating into a 900-ohm load.
7. Digital Output Signal:
- a. Two SPDT relays.
  - b. Each rated for one amp at 30-V ac or dc.
8. Construction:
- a. Die cast-aluminum casing and bezel.
  - b. Threaded, NPS 1/8 (DN 6) connections on side and back.
  - c. Vertical plane mounting.
  - d. NEMA 250, Type 1.
  - e. Nominal 4-inch- (100-mm-) diameter face.
  - f. Mounting Bracket: Appropriate for installation.

## 2.05 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled pressure instruments, as indicated by instrument requirements. Affix standards organization's certification and label.
- B. Prepare test and inspection reports.

**PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION, GENERAL**

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement, sway, or a break in attachment when subjected to a force.
- C. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by using excessive force or oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- F. Corrosive Environments:
  - 1. Use products that are suitable for environment to which they are subjected.
  - 2. If possible, avoid or limit use of materials in corrosive environments.
  - 3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
  - 4. Where instruments are located in a corrosive environment and are not corrosive resistant from the manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

**3.03 ELECTRICAL POWER**

- A. Furnish and install electrical power to products requiring electrical connections.

- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

### **3.04 PRESSURE INSTRUMENT INSTALLATION**

- A. Mounting Location:
  - 1. Rough-in: Outline instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
  - 2. Install switches and transmitters for air and liquid pressure associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
  - 3. Install liquid and steam pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  - 4. Install air-pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  - 5. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
  - 6. Install instruments (except pressure gages) in steam, liquid, and liquid-sealed piped services below their process connection point. Slope tubing down to instrument with a slope of 3 percent.
  - 7. Install instruments in dry gas and non-condensable vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 3 percent.
- B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.
- C. Duct Pressure Sensors:
  - 1. Install sensors using manufacturer's recommended upstream and downstream distances.
  - 2. Unless indicated on Drawings, locate sensors approximately 50 percent of distance of longest hydraulic run. Location of sensors shall be submitted and approved before installation.
  - 3. Install mounting hardware and gaskets to make sensor installation airtight.
  - 4. Route tubing from the sensor to transmitter.
  - 5. Use compression fittings at terminations.
  - 6. Install sensor in accordance with manufacturer's instructions.
  - 7. Support sensor to withstand maximum air velocity, turbulence, and vibration encountered to prevent instrument failure.
- D. Outdoor Pressure Sensors:
  - 1. Install roof-mounted sensor in least-noticeable location and as far away from exterior walls as possible.
  - 2. Locate wall-mounted sensor in an inconspicuous location.
  - 3. Submit sensor location for approval before installation.

4. Verify signal from sensor is stable and consistent to all connected transmitters. Modify installation to achieve proper signal.
  5. Route outdoor signal pipe full size of sensor connection to transmitters. Install branch connection of size required to match to transmitter.
  6. Install sensor signal pipe with dirt leg and drain valve below roof penetration.
  7. Insulate signal pipe with flexible elastomeric insulation as required to prevent condensation.
  8. Connect roof-mounted signal pipe exposed to outdoors to building grounding system.
- E. Air-Pressure Differential Switches:
1. Install air-pressure sensor in system for each switch connection. Install sensor in an accessible location for inspection and replacement.
  2. A single sensor may be used to share a common signal to multiple pressure instruments.
  3. Install access door in duct and equipment to access sensors that cannot be inspected and replaced from outside.
  4. Route NPS 3/8 (DN 12) tubing from sensor to switch connection.
  5. Do not mount switches on rotating equipment.
  6. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
  7. Install switches in an easily accessible location serviceable from floor.
  8. Install switches adjacent to system control panel if within 50 feet otherwise, locate switch in vicinity of system connection.

### **3.05 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

### **3.06 CHECKOUT PROCEDURES**

- A. Check out installed products before continuity tests, leak tests, and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

### **3.07 ADJUSTMENT, CALIBRATION, AND TESTING**

- A. Description:
1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
  2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
  3. For each analog instrument, perform a three-point calibration test for both linearity and accuracy.
  4. Equipment and procedures used for calibration shall comply with instrument manufacturer's recommendations.
  5. Provide diagnostic and test equipment for calibration and adjustment.

6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
  7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
  8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.
  9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.
- B. Analog Signals:
1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
  2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
- C. Digital Signals:
1. Check digital signals using a jumper wire.
  2. Check digital signals using an ohmmeter to test for contact.
- D. Sensors: Check sensors at zero, 50, and 100 percent of project design values.
- E. Switches: Calibrate switches to make or break contact at set points indicated.
- F. Transmitters:
1. Check and calibrate transmitters at zero, 50, and 100 percent of project design values.

### **3.08 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### **3.09 MAINTENANCE SERVICE**

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of systems and equipment Installer. Include semiannual preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### **3.10 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.
- B. Coordinate pressure instrument demonstration video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- C. Record videos on DVD disks.
- D. Owner shall have right to make additional copies of video for internal use without paying royalties.

**END OF SECTION 230923.23**



**SECTION 230923.27****TEMPERATURE INSTRUMENTS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Air temperature sensors.
  - 2. Combination air temperature sensors and switches.
  - 3. Air temperature switches.
  - 4. Air temperature RTD transmitters.
- B. Related Requirements:
  - 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
  - 2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.27.

**1.03 DEFINITIONS**

- A. HART (Highway Addressable Remote Transducer) Protocol: The global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bidirectional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from a technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.
- B. RTD: Resistance temperature detector.

**1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including the following:
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 3. Product description with complete technical data, performance curves, and product specification sheets.
  - 4. Installation operation and maintenance instructions, including factors affecting performance.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting details.

2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

C. Samples: For each exposed product installed in finished space.

#### **1.05 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Product installation location shown in relationship to room, duct, pipe, and equipment.
  2. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
  3. Sizes and locations of wall access panels for instruments installed behind walls.
  4. Sizes and locations of ceiling access panels for instruments installed in inaccessible ceilings.
- B. Product Certificates: For each product requiring a certificate.
- C. Product Test Reports: For each product, for tests performed by [manufacturer and witnessed by a qualified testing agency] [a qualified testing agency].
- D. Field quality-control reports.

#### **1.06 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Provide two matching product(s) in Project inventory for each unique size and type of the following:

### **PART 2 - PRODUCTS**

#### **2.01 PERFORMANCE REQUIREMENTS**

- A. Environmental Conditions:
1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
    - a. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated filtered, and ventilated as required by instrument and application.
  2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:
    - a. Outdoors, Protected: **Type 3**
    - b. Outdoors, Unprotected: **Type 4X**.

- c. Indoors, Heated with Filtered Ventilation: **Type 1**
- d. Indoors, Heated with Non-Filtered Ventilation: **Type 2**
- e. Indoors, Heated and Air Conditioned: **Type 1**
- f. Mechanical Equipment Rooms:
  - 1) Air-Moving Equipment Rooms: **Type 1**
- g. Localized Areas Exposed to Washdown: **Type 4X**
- h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: **Type 2**
- i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: **Type 4**
- j. Hazardous Locations: Explosion-proof rating for condition.

## 2.02 AIR TEMPERATURE SENSORS

- A. Platinum RTDs: Common Requirements:
  - 1. 100 or 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
  - 2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
  - 3. Performance Characteristics:
    - a. Range: **Minus 50 to 275 deg F (Minus 46 to 135 deg C)**.
    - b. Interchangeable Accuracy: At **32 deg F (zero deg C)** within **0.5 deg F (0.3 deg C)**.
    - c. Repeatability: Within **0.5 deg F (0.3 deg C)**.
    - d. Self-Heating: Negligible.
  - 4. Transmitter Requirements:
    - a. Transmitter required for each 100-ohm RTD.
    - b. Transmitter optional for 1000-ohm RTD, contingent on compliance with end-to-end control accuracy.
- B. Platinum RTD, Single-Point Air Temperature Duct Sensors:
  - 1. 100 or 1000 ohms.
  - 2. Temperature Range: **Minus 50 to 275 deg F (Minus 45 to 135 deg C)**.
  - 3. Probe: Single-point sensor with a stainless-steel sheath.
  - 4. Length: As required by application to achieve tip at midpoint of air tunnel, up to **18 inches (450 mm) long**.
  - 5. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
  - 6. Gasket for attachment to duct or equipment to seal penetration airtight.
  - 7. Conduit Connection: **1/2-inch (16-mm) trade size.**
- C. Platinum RTD, Air Temperature Averaging Sensors:
  - 1. 100 or 1000 ohms.
  - 2. Temperature Range: **Minus 50 to 275 deg F (Minus 45 to 135 deg C)**.
  - 3. Multiple sensors to provide average temperature across entire length of sensor.
  - 4. Rigid probe of aluminum, brass, copper, or stainless-steel sheath.
  - 5. Flexible probe of aluminum, brass, copper, or stainless-steel sheath and formable to a **4-inch (100-mm) radius**.
  - 6. Length: As required by application to cover entire cross section of air tunnel.
  - 7. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
  - 8. Gasket for attachment to duct or equipment to seal penetration airtight.
  - 9. Conduit Connection: **1/2-inch (16-mm) trade size.**
- D. Platinum RTD Outdoor Air Temperature Sensors:
  - 1. 100 or 1000 ohms.
  - 2. Temperature Range: **Minus 50 to 275 deg F (Minus 45 to 135 deg C)**.
  - 3. Probe: Single-point sensor with a stainless-steel sheath.

4. Solar Shield: Stainless steel.
  5. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.
  6. Conduit Connection: **1/2-inch (16-mm)** trade size.
- E. Platinum RTD Space Air Temperature Sensors:
1. 100 or 1000 ohms.
  2. Temperature Range: **Minus 50 to 212 deg F (Minus 45 to 100 deg C)**.
  3. Sensor assembly shall include a temperature sensing element mounted under a bright white, non-yellowing, plastic cover.
  4. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
  5. Concealed wiring connection.
- F. Thermal Resistors (Thermistors): Common Requirements:
1. 10,000 ohms at 25 deg C and a temperature coefficient of 23.5 ohms/ohm/deg C.
  2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
  3. Performance Characteristics:
    - a. Range: **Minus 50 to 275 deg F (Minus 46 to 135 deg C)**.
    - b. Interchangeable Accuracy: At **77 deg F (25 deg C)** within **0.5 deg F (0.3 deg C)**.
    - c. Repeatability: Within **0.5 deg F (0.3 deg C)**.
    - d. Drift: Within **0.5 deg F (0.3 deg C)** over 10 years.
    - e. Self-Heating: Negligible.
  4. Transmitter optional, contingent on compliance with end-to-end control accuracy.
- G. Thermistor, Single-Point Duct Air Temperature Sensors:
1. Temperature Range: **Minus 50 to 275 deg F (Minus 45 to 135 deg C)**.
  2. Probe: Single-point sensor with a stainless-steel sheath.
  3. Length: As required by application to achieve tip at midpoint of air tunnel, up to **18 inches (450 mm) long**.
  4. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
  5. Gasket for attachment to duct or equipment to seal penetration airtight.
  6. Conduit Connection: **1/2-inch (16-mm)** trade size.
- H. Thermistor Averaging Air Temperature Sensors:
1. Temperature Range: **Minus 50 to 275 deg F (Minus 45 to 135 deg C)**.
  2. Multiple sensors to provide average temperature across entire length of sensor.
  3. Rigid probe of aluminum, brass, copper, or stainless-steel sheath.
  4. Flexible probe of aluminum, brass, copper, or stainless-steel sheath and formable to a **4-inch (100-mm)** radius.
  5. Length: As required by application to cover entire cross section of air tunnel.
  6. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
  7. Gasket for attachment to duct or equipment to seal penetration airtight.
  8. Conduit Connection: **1/2-inch (16-mm)** trade size.
- I. Thermistor Outdoor Air Temperature Sensors:
1. Temperature Range: **Minus 50 to 275 deg F (Minus 45 to 135 deg C)**.
  2. Probe: Single-point sensor with a stainless-steel sheath.
  3. Solar Shield: Stainless steel.
  4. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.
  5. Conduit Connection: **1/2-inch (16-mm)** trade size.
- J. Thermistor Space Air Temperature Sensors:

1. Temperature Range: **Minus 50 to 212 deg F (Minus 45 to 100 deg C)**.
  2. Sensor assembly shall include a temperature sensing element mounted under a bright white, non-yellowing, plastic cover.
  3. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
  4. Concealed wiring connection.
- K. Space Air Temperature Sensors for Use with DDC Controllers Controlling Terminal Units:
1. 100 or 1000-ohm platinum RT or thermistor].
  2. Thermistor:
    - a. Pre-aged, burned in, and coated with glass; inserted in a metal sleeve; and entire unit encased in epoxy.
    - b. Thermistor drift shall be less than plus or minus **0.5 deg F (0.3 deg C)** over 10 years.
  3. Temperature Transmitter Requirements:
    - a. Mating transmitter required with each 100-ohm RTD.
    - b. Mating transmitters optional for 1000-ohm RTD and thermistor, contingent on compliance with end-to-end control accuracy.
  4. Provide digital display of sensed temperature.
  5. Provide sensor with local control.
    - a. Local override to turn HVAC on.
    - b. Local adjustment of temperature set point.
    - c. Both features shall be capable of manual override through control system operator.

## 2.03 COMBINATION AIR TEMPERATURE SENSOR AND SWITCH

- A. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.
- B. Combination temperature sensor and switch in same instrument.
- C. Air Temperature Switch:
  1. Factory preset set point of **38 deg F (3 deg C)**. Field-adjustable set point from **30 to 44 deg F (minus 1 to 7 deg C)**.
  2. Responsive to coldest **12-inch (300-mm)** section of sensor length.
  3. DPST latching relay rated at 25 A and 120-V ac, with powered controller, coil, and manual rest at panel. Wire one leg to fan start circuit and other leg to signal a remote alarm.
- D. Air Temperature Sensor:
  1. Temperature-averaging type over sensor length. Length to be determined by installing trade to provide uniform coverage over air tunnel. Consult manufacturer for recommendations.
  2. Platinum RTD with a value of 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
  3. Accuracy: Within **0.9 deg F (0.5 deg C)**.
  4. Output Signal: 4 to 20 mA for connection to remote monitoring.
  5. Encase RTDs in a flexible nominal **0.375-inch- (9-mm-)** diameter sheath constructed of brass.
  6. Lead wires shall be 18-gage AWG copper.
  7. Enclosure: NEMA 250, Type 4.

## 2.04 AIR TEMPERATURE SWITCHES

- A. Thermostat and Switch for Low Temperature Control in Duct Applications:
  1. Description:

- a. Two-position control.
  - b. Field-adjustable set point.
  - c. Manual reset.
  - d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Performance:
- a. Operating Temperature Range: **15 to 55 deg F (Minus 9 to 13 deg C)**.
  - b. Temperature Differential: **5 deg F (2.8 deg C)**, non-adjustable and additive.
  - c. Enclosure Ambient Temperature: **Minus 20 to 140 deg F (Minus 11 to 60 deg C)**.
  - d. Sensing Element Maximum Temperature: **250 deg F (121 deg C)**.
  - e. Voltage: 120-V ac.
  - f. Current: 16 FLA.
  - g. Switch Type: Two SPDT snap switches operate on coldest **12-inch (300-mm)** section along element length.
3. Construction:
- a. Vapor-Filled Sensing Element: Nominal **20 feet (6 m)** long.
  - b. Dual Temperature Scale: Fahrenheit and Celsius visible on face.
  - c. Set-Point Adjustment: Screw.
  - d. Enclosure: Painted metal, NEMA 250, Type 1.
  - e. Electrical Connections: Screw terminals.
  - f. Conduit Connection: **1/2-inch (16-mm)** trade size.
- B. Thermostat and Switch for High Temperature Control in Duct Applications:
- 1. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.
  - 2. Description:
    - a. Two-position control.
    - b. Field-adjustable set point.
    - c. Manual reset.
    - d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. Performance:
    - a. Temperature Range: **100 to 160 deg F (38 to 71 deg C)**.
    - b. Temperature Differential: **5 deg F (2.8 deg C)**.
    - c. Ambient Temperature: **Zero to 260 deg F (Minus 18 to 127 deg C)**.
    - d. Voltage: 120-V ac.
    - e. Current: 16 FLA.
    - f. Switch Type: SPDT snap switch.
  - 4. Construction:
    - a. Sensing Element: Helical bimetal.
    - b. Enclosure: Metal, NEMA 250, Type 1.
    - c. Electrical Connections: Screw terminals.
    - d. Conduit Connection: **1/2-inch (16-mm)** trade size.

## 2.05 AIR TEMPERATURE RTD TRANSMITTERS

- A. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.
- B. House electronics in NEMA 250 enclosure.
  - 1. Duct: Type 1
  - 2. Outdoor: Type 4X.
  - 3. Space: Type 1.
- C. Conduit Connection: **1/2-inch (16-mm) trade size.**

- D. Functional Characteristics:
1. Input:
    - a. 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
    - b. 1000-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
  2. Span (Adjustable):
    - a. Space: 40 to 90 deg F (4 to 32 deg C).
    - b. Supply Air Cooling and Heating: 40 to 120 deg F (4 to 49 deg C).
    - c. Supply Air Cooling Only: 40 to 90 deg F (4 to 32 deg C).
    - d. Supply Air Heating Only: 40 to 120 deg F (4 to 49 deg C).
    - e. Exhaust Air: 50 to 100 deg F (10 to 38 deg C).
    - f. Return Air: 50 to 100 deg F (10 to 38 deg C).
    - g. Mixed Air: Minus 40 to 140 deg F (Minus 40 to 60 deg C).
    - h. Outdoor: Minus 40 to 140 deg F (Minus 40 to 60 deg C).
  3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc .
  4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F (28 deg C).
  5. Match sensor with temperature transmitter and factory calibrate together.
- E. Performance Characteristics:
1. Calibration Accuracy: Within 0.1 percent of the span.
  2. Stability: Within 0.2 percent of the span for at least 6 months.
  3. Combined Accuracy: Within 0.5 percent.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.02 TEMPERATURE INSTRUMENT APPLICATIONS

- A. Air Temperature Sensors:
1. Duct, Thermistor, 100-ohm platinum RTD or 1000-ohm platinum RTD.
  2. Outdoor, Thermistor, 100-ohm platinum RTD or 1000-ohm platinum RTD.
  3. Space, Thermistor, 100-ohm platinum RTD or 1000-ohm platinum RTD.
- B. Air Temperature Transmitters:
1. Duct, **Air temperature RTD transmitter.**
  2. Outdoor, **Air temperature RTD transmitter.**
  3. Space, **Air temperature RTD transmitter.**

**3.03 INSTALLATION, GENERAL**

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.
- C. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- E. Corrosive Environments:
  - 1. Use products that are suitable for environment to which they are subjected.
  - 2. If possible, avoid or limit use of materials in corrosive environments.
  - 3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
  - 4. Where instruments are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

**3.04 ELECTRIC POWER**

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

**3.05 TEMPERATURE INSTRUMENT INSTALLATIONS**

- A. Mounting Location:
  - 1. Roughing In:
    - a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
    - b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
      - 1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
      - 2) Do not begin installation without submittal approval of mounting location.



- c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.
  2. Install switches and transmitters for air and liquid temperature associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.
  3. Install liquid and steam temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  4. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
- B. Special Mounting Requirements:
  1. Protect products installed outdoors from solar radiation, building and wind effect with stand-offs and shields constructed of Type 316 stainless.
  2. Temperature instruments having performance impacted by temperature of mounting substrate shall be isolated with an insulating barrier located between instrument and substrate to eliminate effect. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.
- C. Mounting Height:
  1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
  2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of **42 to 72 inches (1.1 to 1.6 m)** above the adjacent floor, grade, or service catwalk or platform.
    - a. Make every effort to mount at **60 inches (1500 mm)**.
- D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.
- E. Space Temperature Sensor Installation:
  1. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if provided.
  2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
  3. In finished areas, recess electrical box within wall.
  4. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted. Use a cast-aluminum electric box for surface-mounted installations.
  5. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.
- F. Outdoor Air Temperature Sensor Installation:
  1. Mount sensor in a discrete location facing north.
  2. Protect installed sensor from solar radiation and other influences that could impact performance.

3. If required to have a transmitter, mount transmitter remote from sensor in an accessible and serviceable location indoors.
- G. Single-Point Duct Temperature Sensor Installation:
1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed **24 inches (610 mm)** in sensor length.
  2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
  3. Rigidly support sensor to duct and seal penetration airtight.
  4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.
- H. Averaging Duct Temperature Sensor Installation:
1. Install averaging-type air temperature sensor for temperature sensors located within air-handling units, similar equipment, and large ducts with air tunnel cross-sectional area of **20 sq. ft. (1.86 sq. m)** and larger.
  2. Install sensor length to maintain coverage over entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
  3. Fasten and support sensor with manufacturer-furnished clips to keep sensor taut throughout entire length.
  4. If required to have transmitter, mount transmitter in an accessible and serviceable location.
- I. Low-Limit Air Temperature Switch Installation:
1. Install multiple low-limit switches to maintain coverage over entire cross-sectional area of air tunnel.
  2. Fasten and support sensing element with manufacturer-furnished clips to keep element taut throughout entire length.
  3. Mount switches outside of airstream at a location and mounting height to provide easy access for switch set-point adjustment and manual reset.
  4. Install on entering side of cooling coil unless otherwise indicated on Drawings.
  5. For applications with transmitters, mount transmitter remote from sensor in an accessible and serviceable location from floor service platform or catwalk.

### **3.06 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with instrument identification on face of ceiling directly below instruments concealed above ceilings].

### **3.07 CLEANING**

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
- B. Wash and shine glazing.
- C. Polish glossy surfaces to a clean shine.

**3.08 CHECK-OUT PROCEDURES**

- A. Check installed products before continuity tests, leak tests, and calibration.
- B. Check temperature instruments for proper location and accessibility.
- C. Verify sensing element type and proper material.
- D. Verify location and length.
- E. Verify that wiring is correct and secure.

**3.09 ADJUSTMENT, CALIBRATION, AND TESTING**

- A. Description:
  - 1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
  - 2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
  - 3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
  - 4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
  - 5. Provide diagnostic and test equipment for calibration and adjustment.
  - 6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
  - 7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
  - 8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
  - 9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements and to supplement requirements indicated.
- B. Analog Signals:
  - 1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
  - 2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
  - 3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.
- C. Digital Signals:
  - 1. Check digital signals using a jumper wire.
  - 2. Check digital signals using an ohmmeter to test for contact.
- D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
- E. Switches: Calibrate switches to make or break contact at set points indicated.
- F. Transmitters:
  - 1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.

2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

### **3.10 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  1. Perform according to manufacturer's written instruction.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

### **3.11 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### **3.12 MAINTENANCE SERVICE**

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of systems and equipment Installer. Include semiannual annual preventive maintenance, repair or replacement of worn or defective components, cleaning and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### **3.13 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.
- B. Provide a complete set of instructional videos covering each product specified and installed and showing the following:
  1. Software programming.
  2. Calibration and test procedures.
  3. Operation and maintenance requirements and procedures.
  4. Troubleshooting procedures.
- C. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- D. Record videos on DVD disks.
- E. Owner shall have right to make additional copies of video for internal use without paying royalties.

### **END OF SECTION 230923.27**

**SECTION 230993.11****SEQUENCE OF OPERATIONS FOR HVAC DDC****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section includes control sequences for DDC for HVAC systems, subsystems, and equipment.
- B. Related Requirements:
  - 1. Section 230923 "DDC Systems for HVAC" for control equipment.

**1.03 DEFINITIONS**

- A. Analog Output: Proportional output signal (zero- to 10-V dc, 4 to 20 mA).
- B. Binary Output: On/off output signal or contact closure.
- C. DDC: Direct digital control.
- D. Digital Output: Data output that must be interpreted digitally.

**1.04 ACTION SUBMITTALS**

- A. Product Data:
  - 1. An instrumentation list for each controlled system. Label each element of the controlled system in table format. Show, in the table element name, type of device, manufacturer, model number, and control device product data sheet number.
  - 2. A complete description of the operation of the control system, including sequences of operation. Include and reference a schematic diagram of the controlled system.
- B. Shop Drawings:
  - 1. Riser diagrams showing control network layout, communication protocol, and wire types.
  - 2. Schematic diagram of each controlled system. Include all control points labeled with point names shown or listed. Show the location of control elements in the system.
  - 3. Wiring diagram for each controlled system. Show all control elements labels. Where a control element is the same as that shown on the control system schematic, label with the same name. Label all terminals.

**1.05 AIR-HANDLING-UNIT CONTROL SEQUENCES**

- A. Air-Handling Unit Time Schedule:
  - 1. Occupied Time Schedule:
    - a. Input:
      - 1) Device: DDC controller.
      - 2) Location: Time schedule.
      - 3) Transference: DDC controller.
    - b. Output:

- 1) Device: DDC controller.
  - c. Action:
    - 1) Enable startup, initiation, and control.
    - 2) Energize unit on occupied/unoccupied cycle.
    - 3) Energize unit on day/night cycle.
    - 4) Energize unit on duty cycle.
    - 5) Do not enable mixed-air control during morning warm-up period.
      - a) Unoccupied: Position outdoor-air and relief air dampers closed and return-air dampers open.
    - 6) Do not enable humidifier control during morning warm-up period.
    - 7) Enable control of heating coil(s) during morning warm-up period.
    - 8) Energize coil circulating pump(s).
    - 9) Do not enable cooling-coil control during morning warm-up period.
- B. Start and Stop Supply Fan(s):
- 1. Enable:
    - a. Input:
      - 1) Device: Low limit temperature switch with automatic reset.
      - 2) Location: Upstream of cooling coil.
      - 3) Transference: Starter relay.
    - b. Output:
      - 1) Device: Hard wired to motor controller and DDC controller.
      - 2) Location: Motor controller.
      - 3) Transference: Starter relay.
    - c. Action:
      - 1) Allow start if temperature is above 37 deg F
      - 2) Signal alarm if fan fails to start as commanded.
  - 2. Enable:
    - a. Input:
      - 1) Device: Low limit temperature switch with automatic reset.
      - 2) Location: Supply airstream
      - 3) Transference: Starter relay.
    - b. Output:
      - 1) Device: Hard wired to motor controller and DDC controller.
      - 2) Location: Motor controller.
      - 3) Input Transference: Starter relay.
    - c. Action:
      - 1) Allow start if temperature is below 120 deg
      - 2) Signal alarm if fan fails to start as commanded.
  - 3. Enable:
    - a. Input:
      - 1) Device: Smoke detector with auxiliary contact automatic reset.
      - 2) Location: Duct mounted before and after supply fan.
      - 3) Location: Mounted in air-handling unit.
      - 4) Transference: Starter relay.
    - b. Output:
      - 1) Device: Hard wired.
      - 2) Location: Motor controller.
      - 3) Transference: Starter relay.
    - c. Output Device: Hard wired through motor controller; DDC controller alarm.
    - d. Action:
      - 1) Allow start if airstream is free of products of combustion.
      - 2) Signal alarm if fan fails to start as commanded.
- C. Filters:
- 1. Differential Pressure:

- a. Input:
    - 1) Device: Pressure differential transmitter.
    - 2) Location: Filter bank.
    - 3) Transference: DDC controller.
  - b. Output:
    - 1) Device: DDC controller.
    - 2) Location: DDC controller.
    - 3) Transference: Operator's workstation.
  - c. Action: Signal alarm on high-pressure conditions.
- D. Coordination of Air-Handling Unit Sequences: Ensure that preheat, mixed-air, heating-coil, and cooling-coil controls have common inputs and do not overlap in function.
- E. Indicate the following on the operator's workstation display terminal:
1. DDC system graphic.
  2. DDC system on-off indication (operating or not operating).
  3. DDC system occupied/unoccupied mode.
  4. Outdoor-air-temperature indication.
  5. Supply-fan on-off indication (operating or not operating).
  6. Supply duct static-pressure indication.
  7. Supply duct static-pressure set point.
  8. Supply-fan airflow rate.
  9. Supply-fan speed.
  10. Space static-pressure indication.
  11. Space static-pressure set point.
  12. Mixed-air-temperature indication.
  13. Mixed-air-temperature set point.
  14. Mixed-air damper position.
  15. Relative humidity indication.
  16. Relative humidity set point.
  17. Relative humidity control-valve position.
  18. Filter air-pressure-drop indication.
  19. Filter low-air-pressure drop set point.
  20. Filter high-air-pressure drop set point.
  21. Supply -air-temperature indication.
  22. Supply air-temperature set point.
  23. Space temperature indication.
  24. Space temperature set point.

## 1.06 TERMINAL UNIT OPERATING SEQUENCE

- A. Cabinet Unit Heater, Electric:
1. Input:
    - a. Device: Line-voltage thermostat.
    - b. Location: Occupied space.
  2. Output:
    - a. Device: Hard wired.
    - b. Location: Motor-controller and heater relay.
    - c. Transference: Starter relay.
  3. Action: Cycle fan to maintain 75 deg F
    - 1)
- B. Sequence Control:
1. Space Temperature:
    - a. Input:

- 1) Device: air-temperature sensor or air-temperature sensor with air-temperature RTD transmitter.
  - 2) Location: Space.
  - 3) Transference: DDC controller.
- b. Output:
- 1) Device: Analog output.
  - 2) Location: Control damper and valve actuators.
  - 3) Input Transference: Control dampers and valves.
- C. Indicate the following on the operator's workstation display terminal:
1. DDC system graphic.
  2. DDC system on-off indication (operating or not operating).
  3. DDC system occupied/unoccupied mode.
  4. Outdoor-air-temperature indication.
  5. Sequence Control:
    - a. Space/area served.
    - b. Space occupied/unoccupied.
    - c. Space temperature indication.
    - d. Space temperature set point, occupied.
    - e. Space temperature set point, unoccupied.
    - f. Damper position as percentage open.

#### **1.07 VENTILATION SEQUENCES**

- A. Gravity Roof Ventilator:
1. Input:
    - a. Device: Electric thermostat.
    - b. Location: Space.
  2. Output:
    - a. Device: Hard wired.
    - b. Location: Control damper.
    - c. Transference: Damper actuator.
  3. Action: Open control damper when space temperature rises above set point.
- B. Exhaust Fan: Occupancy sensor.
1. Input:
    - a. Device: Occupancy sensor.
    - b. Location: Space.
  2. Output:
    - a. Device: Hard wired.
    - b. Location: Motor controller.
    - c. Transference: Starter relay.
  3. Action: Cycle fan on when space is occupied.

#### **PART 2 - PRODUCTS (Not Applicable)**

#### **PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 230993.11**



**SECTION 232300**  
**REFRIGERANT PIPING**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Refrigerant pipes and fittings.
  2. Refrigerant piping valves and specialties.
  3. Refrigerants.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of valve, refrigerant piping, and piping specialty.
1. Include pressure drop, based on manufacturer's test data, for the following:
    - a. Thermostatic expansion valves.
    - b. Solenoid valves.
    - c. Hot-gas bypass valves.
    - d. Filter dryers.
    - e. Strainers.
    - f. Pressure-regulating valves.
- B. Sustainable Design Submittals:
- C. Shop Drawings:
1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
  2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
  3. Show interface and spatial relationships between piping and equipment.
  4. Shop Drawing Scale: 1/8 inch equals 1 foot

**1.04 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Field quality-control reports.

**1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

**1.06 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

**1.07 PRODUCT STORAGE AND HANDLING**

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Line Test Pressure for Refrigerant R-134a:
  1. Suction Lines for Air-Conditioning Applications: 115 psig (793 kPa).
  2. Suction Lines for Heat-Pump Applications: 225 psig (1551 kPa).
  3. Hot-Gas and Liquid Lines: 225 psig (1551 kPa).
- B. Line Test Pressure for Refrigerant R-407C:
  1. Suction Lines for Air-Conditioning Applications: 230 psig (1586 kPa).
  2. Suction Lines for Heat-Pump Applications: 380 psig (2620 kPa).
  3. Hot-Gas and Liquid Lines: 380 psig (2620 kPa).
- C. Line Test Pressure for Refrigerant R-410A:
  1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
  2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
  3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

**2.02 COPPER TUBE AND FITTINGS**

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Flexible Connectors:
  1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  2. End Connections: Socket ends.
  3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
  4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
  5. Maximum Operating Temperature: 250 deg F (121 deg C).

- G. Copper Pressure-Seal Fittings for Refrigerant Piping:
  - 1. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
  - 2. Housing: Copper.
  - 3. O-Rings: HNBR or compatible with specific refrigerant.
  - 4. Tools: Manufacturer's approved special tools.
  - 5. Minimum Rated Pressure: 700 psig (48 bar).

### **2.03 STEEL PIPE AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as selected in piping application articles.
- B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.
- C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Flanged Unions:
  - 1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 (DN 25 to DN 40) and ductile iron for NPS 2 to NPS 3 (DN 50 to DN 80). Apply rust-resistant finish at factory.
  - 2. Gasket: Fiber asbestos free.
  - 3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
  - 4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
  - 5. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
  - 6. Pressure Rating: Factory test at minimum 400 psig (2760 kPa).
  - 7. Maximum Operating Temperature: 330 deg F (165 deg C).
- F. Flexible Connectors:
  - 1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket.
  - 2. End Connections:
    - a. NPS 2 (DN 50) and Smaller: With threaded-end connections.
    - b. NPS 2-1/2 (DN 65) and Larger: With flanged-end connections.
  - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
  - 4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
  - 5. Maximum Operating Temperature: 250 deg F (121 deg C).

### **2.04 VALVES AND SPECIALTIES**

- A. Diaphragm Packless Valves:
  - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
  - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
  - 3. Operator: Rising stem and hand wheel.
  - 4. Seat: Nylon.
  - 5. End Connections: Socket, union, or flanged.
  - 6. Working Pressure Rating: 500 psig (3450 kPa).
  - 7. Maximum Operating Temperature: 275 deg F (135 deg C).

- B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
  2. Packing: Molded stem, back seating, and replaceable under pressure.
  3. Operator: Rising stem.
  4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
  5. Seal Cap: Forged-brass or valox hex cap.
  6. End Connections: Socket, union, threaded, or flanged.
  7. Working Pressure Rating: 500 psig (3450 kPa).
  8. Maximum Operating Temperature: 275 deg F (135 deg C).
- C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
  2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
  3. Piston: Removable polytetrafluoroethylene seat.
  4. Closing Spring: Stainless steel.
  5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
  6. End Connections: Socket, union, threaded, or flanged.
  7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
  8. Working Pressure Rating: 500 psig (3450 kPa).
  9. Maximum Operating Temperature: 275 deg F (135 deg C).
- D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
  2. Core: Removable ball-type check valve with stainless-steel spring.
  3. Seat: Polytetrafluoroethylene.
  4. End Connections: Copper spring.
  5. Working Pressure Rating: 500 psig (3450 kPa).
- E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Body and Bonnet: Plated steel.
  2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  3. Seat: Polytetrafluoroethylene.
  4. End Connections: Threaded.
  5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 115-V ac coil.
  6. Working Pressure Rating: 400 psig (2760 kPa).
  7. Maximum Operating Temperature: 240 deg F (116 deg C).
- F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1.  $\leq$
  2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  3. Piston, Closing Spring, and Seat Insert: Stainless steel.
  4. Seat: Polytetrafluoroethylene.
  5. End Connections: Threaded.
  6. Working Pressure Rating: 400 psig (2760 kPa).
  7. Maximum Operating Temperature: 240 deg F (116 deg C).
- G. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
  2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Packing and Gaskets: Non-asbestos.
  4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  5. Suction Temperature: 40 deg F
  6. Superheat: Adjustable.

7. Reverse-flow option (for heat-pump applications).
  8. End Connections: Socket, flare, or threaded union.
  9. Working Pressure Rating: 700 psig (4820 kPa)
- H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
  2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Packing and Gaskets: Non-asbestos.
  4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  5. Seat: Polytetrafluoroethylene.
  6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter and 115-V ac coil.
  7. End Connections: Socket.
  8. Throttling Range: Maximum 5 psig (34 kPa).
  9. Working Pressure Rating: 500 psig (3450 kPa).
  10. Maximum Operating Temperature: 240 deg F (116 deg C).
- I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
  2. Screen: 100-mesh stainless steel.
  3. End Connections: Socket or flare.
  4. Working Pressure Rating: 500 psig (3450 kPa).
  5. Maximum Operating Temperature: 275 deg F (135 deg C).
- J. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
  2. Drain Plug: Brass hex plug.
  3. Screen: 100-mesh monel.
  4. End Connections: Socket or flare.
  5. Working Pressure Rating: 500 psig (3450 kPa).
  6. Maximum Operating Temperature: 275 deg F (135 deg C).
- K. Moisture/Liquid Indicators:
1. Body: Forged brass.
  2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
  3. Indicator: Color coded to show moisture content in parts per million (ppm).
  4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
  5. End Connections: Socket or flare.
  6. Working Pressure Rating: 500 psig (3450 kPa).
  7. Maximum Operating Temperature: 240 deg F (116 deg C).
- L. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
  2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
  3. Desiccant Media: Activated charcoal.
  4. Designed for reverse flow (for heat-pump applications).
  5. End Connections: Socket.
  6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
  7. Maximum Pressure Loss: 2 psig
  8. Working Pressure Rating: 500 psig (3450 kPa).
  9. Maximum Operating Temperature: 240 deg F (116 deg C).
- M. Permanent Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig (14 kPa)
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 240 deg F (116 deg C).

N. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 deg F (135 deg C).

O. Receivers: Comply with AHRI 495.

1. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

P. Liquid Accumulators: Comply with AHRI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 deg F (135 deg C).

## 2.05 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

## PART 3 - EXECUTION

### 3.01 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR annealed- or drawn-temper tubing and wrought-copper fittings with breazed joints.

### 3.02 VALVE AND SPECIALTY APPLICATIONS

- A. Install valves and specialties per manufacturer's instructions.

**3.03 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

- Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
1. Shot blast the interior of piping.
  2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
  3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
  4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
  5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
  6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### **3.04 PIPE JOINT CONSTRUCTION**

- A. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

### **3.05 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
  2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
  5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.



- E. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

**3.06 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Comply with ASME B31.5, Chapter VI.
  - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if not rated above the test pressure.
- B. Prepare test and inspection reports.

**END OF SECTION 232300**

**SECTION 233113****METAL DUCTS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Duct liner.
  - 5. Sealants and gaskets.
  - 6. Hangers and supports.
- B. Related Sections:
  - 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
  - 3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
- B. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 4. Elevation of top and bottom of ducts.
  - 5. Dimensions of all duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.
  - 10. Equipment installation based on equipment being used on Project.
  - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  - 12. Hangers and supports, including methods for duct and building attachment, and vibration isolation.
- C. Delegated-Design Submittal:
  - 1. Sheet metal thicknesses.

2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

#### **1.04 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Field quality-control reports.

### **PART 2 - PRODUCTS**

#### **2.01 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

#### **2.02 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

**2.03 SINGLE-WALL ROUND AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

**2.04 SHEET METAL MATERIALS**

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
  - 1. Galvanized Coating Designation: G60 (Z180).
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. Factory- or Shop-Applied Antimicrobial Coating:
  - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
  - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
  - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  - 5. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

- E. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch- (6-mm-) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch- (10-mm-) minimum diameter for lengths longer than 36 inches (900 mm).

## 2.05 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.
  - 2. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
    - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.
  - 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA Inc.
    - b. Armacell LLC.
    - c. Rubatex International, LLC
  - 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  - 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
    - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Insulation Pins and Washers:
  - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
  - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
  7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
  8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.
  9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    - a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.
  10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.06 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: 4 inches (102 mm).
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
  7. Service: Indoor and outdoor.
  8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.07 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

### **PART 3 - EXECUTION**

#### **3.01 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.



- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Elbows: Use long-radius elbows wherever they fit.
  1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
  2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.
- N. Branch Connections: Use lateral or conical branch connections.

### **3.02 INSTALLATION OF EXPOSED DUCTWORK**

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### **3.03 DUCT SEALING**

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  2. Outdoor, Supply-Air Ducts: Seal Class A.
  3. Outdoor, Exhaust Ducts: Seal Class C.
  4. Outdoor, Return-Air Ducts: Seal Class C.
  5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
  6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
  7. Unconditioned Space, Exhaust Ducts: Seal Class C.
  8. Unconditioned Space, Return-Air Ducts: Seal Class B.
  9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
  10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
  11. Conditioned Space, Exhaust Ducts: Seal Class B.

12. Conditioned Space, Return-Air Ducts: Seal Class C.

### **3.04 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1220 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### **3.05 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.06 PAINTING**

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 Painting Sections.

### **3.07 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:
  1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

2. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
  3. Test for leaks before applying external insulation.
  4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  5. Give 7 days' advance notice for testing.
- C. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.
  2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.08 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."
- C. Use duct cleaning methodology as indicated in NADCA ACR.
- D. Use service openings for entry and inspection.
1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  3. Remove and reinstall ceiling to gain access during the cleaning process.
- E. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- F. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
  2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  4. Coils and related components.

5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

### 3.09 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Supply Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive 1-inch wg (250 Pa).
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12 .
  2. Ducts Connected to Constant-Volume Air-Handling Units:
    - a. Pressure Class: Positive 2-inch wg (500 Pa)inch wg (750 Pa).
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 3-inch wg (750 Pa)
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round: 6.
- C. Return Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
    - b. Minimum SMACNA Seal Class: B.

- c. SMACNA Leakage Class for Rectangular: 12
      - d. SMACNA Leakage Class for Round: 12.
    - 2. Ducts Connected to Air-Handling Units:
      - a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
      - b. Minimum SMACNA Seal Class: B
      - c. SMACNA Leakage Class for Rectangular: 12.
      - d. SMACNA Leakage Class for Round: 12.
    - 3. Ducts Connected to Equipment Not Listed Above:
      - a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
      - b. Minimum SMACNA Seal Class: B.
      - c. SMACNA Leakage Class for Rectangular: 12.
      - d. SMACNA Leakage Class for Round: 12.
- D. Exhaust Ducts:
  - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 1-inch wg (250 Pa).
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units
    - a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 1-inch wg (250 Pa)
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
  - 3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
- F. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
- G. Liner:
  - 1. Supply Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1-1/2 inches (38 mm) thick.
  - 2. Return Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1-1/2 inches (38 mm) thick.
  - 3. Exhaust Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 inch (25 mm) thick.
  - 4. Supply Fan Plenums: Fibrous glass, Type II or Flexible elastomeric, 1-1/2 inches (38 mm) thick.
  - 5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II or Flexible elastomeric, 2 inches (51 mm) thick.
  - 6. Transfer Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 inch (25 mm) thick.

**H. Elbow Configuration:**

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm (5 m/s) or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm (7.6 m/s) or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam or Welded.

**I. Branch Configuration:**

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
  - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

**END OF SECTION 233113**

**SECTION 233300****AIR DUCT ACCESSORIES****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

Section Includes:

1. Manual volume dampers.
2. Fire dampers.
3. Ceiling radiation dampers.
4. Combination fire and smoke dampers.
5. Duct-mounted access doors.
6. Flexible connectors.
7. Flexible Ducts

**1.03 ACTION SUBMITTALS**

Product Data: For each type of product.

Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
  - a. Special fittings.
  - b. Manual volume damper installations.
  - c. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
  - d. Include diagrams for power, signal, and control wiring.

**1.04 INFORMATIONAL SUBMITTALS**

Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

**1.05 CLOSEOUT SUBMITTALS**

Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

**1.06 MAINTENANCE MATERIAL SUBMITTALS**

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

## **PART 2 - PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

Comply with NFPA 90A and NFPA 90B.

Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

### **2.02 MANUAL VOLUME DAMPERS**

Standard, Steel, Manual Volume Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
  - a. Air Balance Inc.; a division of Mestek, Inc.
  - b. American Warming and Ventilating; a division of Mestek, Inc.
  - c. Flexmaster U.S.A., Inc.
  - d. McGill AirFlow LLC.
  - e. Nailor Industries Inc.
  - f. Pottorff.
  - g. Ruskin Company.
  - h. Trox USA Inc.
  - i. Vent Products Company, Inc.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
  - a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized steel, 0.064 inch (1.62 mm) thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
  - a. Molded synthetic.
  - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

### **2.03 FIRE DAMPERS**

Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Greenheck Fan Corporation.
2. McGill AirFlow LLC.
3. METALAIRE, Inc.
4. Nailor Industries Inc.
5. NCA Manufacturing, Inc.
6. Pottorff; a division of PCI Industries, Inc.
7. Prefco; Perfect Air Control, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.



10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.

Fire Rating: 1-1/2 and/or 3 hours.

Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

11. Minimum Thickness: 0.138 inch (3.5 mm) or 0.39 inch (9.9 mm) thick, as indicated, and of length to suit application.
12. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

Mounting Orientation: Vertical or horizontal as indicated.

Blades: Roll-formed, interlocking, 0.024-inch- (0.61-mm) or 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

Horizontal Dampers: Include blade lock and stainless-steel closure spring.

Heat-Responsive Device: Electric, replaceable link and switch package, factory installed, 165 deg F (74 deg C) rated.

## 2.04 CEILING RADIATION DAMPERS

Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Nailor Industries Inc.
4. Pottorff.
5. Prefco; Perfect Air Control, Inc.
6. Ruskin Company.
7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

General Requirements:

8. Labeled according to UL 555C by an NRTL.
9. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

Blades: Galvanized sheet steel with refractory insulation.

Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

Fire Rating: 1, 2 or 3 hours.

## 2.05 COMBINATION FIRE AND SMOKE DAMPERS

Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.

Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.

Fire Rating: 1-1/2 and 3 hours. Type 304, stainless-steel dampers are available for corrosive atmospheres.

Frame: Hat-shaped, 16 Ga 5 inches x minimum 16 gage (127 x minimum 1.6 mm) roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gage (2.3 mm) U-channel type frame. Retain one of two "Heat-Responsive Device" paragraphs below for either fusible or resettable links.

Heat-Responsive Device: Resettable, 165 deg F (74 deg C) rated, fire-closure device.

Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

Smoke Detector: Integral, factory wired for single-point connection.

Blades: Roll-formed, horizontal, overlapping, 0.063-inch- (1.6-mm-) thick, galvanized sheet steel.

Leakage: Class I.

Rated pressure and velocity to exceed design airflow conditions.

Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.

Master control panel for use in dynamic smoke-management systems.

Damper Motors: two-position action.

Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

7. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
8. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
9. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
10. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or

adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).

11. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
12. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
13. Electrical Connection: 115 V, single phase, 60 Hz.

## 2.06 DUCT-MOUNTED ACCESS DOORS

General Description: Fabricate doors airtight and suitable for duct pressure class.

Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

1. Manufacturers:
  - a. Ductmate Industries, Inc.
  - b. Flexmaster U.S.A., Inc.
  - c. Greenheck.
  - d. McGill AirFlow Corporation.
  - e. Nailor Industries Inc.
  - f. Ventfabrics, Inc.
  - g. Ward Industries, Inc.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:
  - a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.
  - b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.
  - c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
  - d. Sizes 24 by 48 Inches (600 by 1200 mm) and Larger: One additional hinge.

Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.

4. Manufacturers:
  - a. CESCO Products.
  - b. Ductmate Industries, Inc.
  - c. Greenheck.
  - d. KEES, Inc.
  - e. McGill AirFlow Corporation.
  - f. Ruskin
5. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

## 2.07 FLEXIBLE CONNECTORS

Manufacturers:

1. Ventaire.
2. Z-Flex.
3. Safe Air.

General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Select metal compatible with ducts.

Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

4. Minimum Weight: 26 oz. /sq. yd. (880 g/sq. m).
5. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
6. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

## 2.08 FLEXIBLE DUCTS

Manufacturers:

1. Ductmate Industries, Inc.
2. Flexmaster U.S.A., Inc.
3. Hart & Cooley, Inc.
4. McGill AirFlow Corporation.

Insulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor barrier film.

5. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
6. Maximum Air Velocity: 4000 fpm (20.3 m/s).
7. Temperature Range: Minus 20 to plus 210 deg F (Minus 28 to plus 99 deg C).

Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches (75 to 450 mm) to suit duct size.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.

Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

Set dampers to fully open position before testing, adjusting, and balancing.

Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.

Install fire and fire/smoke dampers in accordance with UL listing.

Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment.

Install flexible connectors to connect ducts to equipment.

Install duct test holes where required for testing and balancing purposes.

### **3.02 FIELD QUALITY CONTROL**

Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION 233300**

**SECTION 233346****FLEXIBLE DUCTS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Non-insulated flexible ducts.
  - 2. Insulated flexible ducts.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For flexible ducts.
  - 1. Include plans showing locations and mounting and attachment details.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

**PART 2 - PRODUCTS****2.01 ASSEMBLY DESCRIPTION**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E96/E96M, "Test Methods for Water Vapor Transmission of Materials."

**2.02 INSULATED FLEXIBLE DUCTS**

- A. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
  - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
  - 3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
  - 4. Insulation R-Value: Comply with ASHRAE/IES 9s0.1.

- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
  2. Maximum Air Velocity: 4000 fpm (20 m/s).
  3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
  4. Insulation R-Value: Comply with ASHRAE/IES 90.1
  
- C. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
  2. Maximum Air Velocity: 4000 fpm (20 m/s).
  3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
  4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

### 2.03 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Nylon strap in sizes 3 through 18 inches to suit duct size.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect flexible ducts to metal ducts with draw bands.
- E. Install duct test holes where required for testing and balancing purposes.
- F. Installation:
  1. Install ducts fully extended.
  2. Do not bend ducts across sharp corners.
  3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  5. Install flexible ducts in a direct line, without sags, twists, or turns.
- G. Supporting Flexible Ducts:
  1. Suspend flexible ducts with bands 1-1/2 inches (38 mm) wide or wider and spaced a maximum of 48 inches (1200 mm) apart. Maximum centerline sag between supports shall not exceed 1/2 inch (13 mm) per 12 inches (300 mm).
  2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
  3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
  4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches (1800 mm) o.c.

## END OF SECTION 233346

**SECTION 233423****HVAC POWER VENTILATORS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Ceiling-mounted ventilators.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
  - 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
  - 3. Certified fan performance curves with system operating conditions indicated.
  - 4. Certified fan sound-power ratings.
  - 5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 6. Material thickness and finishes, including color charts.
  - 7. Dampers, including housings, linkages, and operators.
  - 8. Prefabricated roof curbs.
  - 9. Fan speed controllers.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
  - 4. Design Calculations: Calculate requirements for selecting vibration isolators.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Field quality-control reports.

**1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.



**1.06 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

**2.02 CEILING-MOUNTED VENTILATORS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Acme Engineering & Manufacturing Corporation.
  - 2. Breidert Air Products.
  - 3. Carnes Company.
  - 4. Greenheck Fan Corporation.
  - 5. Loren Cook Company.
  - 6. PennBarry.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.
- D. Back-draft damper: Integral..
- E. Grille: Plastic, Stainless steel, Aluminum, or Painted aluminum, louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories:
  - 1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
  - 3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
  - 4. Motion Sensor: Motion detector with adjustable shutoff timer.
  - 5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless steel springs, and fusible link.
  - 6. Filter: Washable aluminum to fit between fan and grille.
  - 7. Isolation: Rubber-in-shear vibration isolators.

8. Manufacturer's standard roof jack or wall cap, and transition fittings.

### **2.03 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors.
  1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

### **2.04 SOURCE QUALITY CONTROL**

- A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
- B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.
- C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION, GENERAL**

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
  1. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Install units with clearances for service and maintenance.

### **3.02 DUCTWORK CONNECTIONS**

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

### **3.03 ELECTRICAL CONNECTIONS**

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

### **3.04 CONTROL CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

**3.05 STARTUP SERVICE:**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Verify that shipping, blocking, and bracing are removed.
  - 3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 4. Verify that cleaning and adjusting are complete.
  - 5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Remove and replace malfunctioning units and retest as specified above.

**3.06 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Lubricate bearings.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

**3.07 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

**3.08 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

**END OF SECTION 233423**

**SECTION 233713.13****AIR DIFFUSERS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Rectangular and square ceiling diffusers.
  - 2. Louver face diffusers.
  - 3. Linear slot diffusers.
- B. Related Requirements:
  - 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
  - 2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

**PART 2 - PRODUCTS****2.01 RECTANGULAR AND SQUARE CEILING DIFFUSERS**

- A. Manufacturers:
  - 1. Titus
  - 2. Price Industries
  - 3. Nailor industries Inc.
  - 4. Tuttle & Bailey
- B. Material: Steel or Aluminum as indicated on drawings.
- C. Finish: Color selected by Architect.
- D. Face Size: As indicated on drawings.
- E. Face Style: Plaque.
- F. Mounting: Refer to Architectural ceiling plan for exact mounting type.
- G. Dampers: Opposed blade.

**2.02 LOUVER FACE DIFFUSERS**

- A. Manufacturers:
  - 1. Titus
  - 2. Price Industries
  - 3. Nailor Industries Inc.
  - 4. Tuttle & Bailey
- B. Material: **Steel** or **Aluminum** as indicated on plans.
- C. Finish: Color selected by Architect.
- D. Face Size: As indicated on drawings.
- E. Mounting: Refer to Architectural ceiling plan for exact mounting type..
- F. Dampers: Opposed blade.
- G. Accessories:
  - 1. Square to round neck adaptor.
  - 2. Adjustable pattern vanes.
  - 3. Throw reducing vanes.
  - 4. Equalizing grid.
  - 5. Plaster ring.
  - 6. Safety chain.
  - 7. Wire guard.
  - 8. Sectorizing baffles.
  - 9. Operating rod extension.

**2.03 LINEAR SLOT DIFFUSERS**

- A. Manufacturers:
  - 1. Titus
  - 2. Price Industries
  - 3. Nailor Industries Inc.
  - 4. Tuttle & Bailey
- B. Material - Shell: Aluminum, insulated.
- C. Material - Pattern Controller and Tees: Aluminum.
- D. Finish - Face and Shell: Color to be selected by Architect.
- E. Slot Width: 1-1/2 inches.
- F. Number of Slots: One.
- G. Length: 48 **inches**.

**2.04 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION**

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

**3.03 ADJUSTING**

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 233713.13**

**SECTION 233713.23****REGISTERS AND GRILLES****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Adjustable blade face **grilles**.
  2. Fixed face **grilles**.
- B. Related Requirements:
1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
  2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

**PART 2 - PRODUCTS****2.01 GRILLES**

- A. Adjustable Blade Face Grille:
1. Manufacturers:
    - a. Titus
    - b. Price Industries
    - c. Nailor Industries Inc.
    - d. Tuttle & Bailey
  2. Material: Steel or Aluminum as indicated on drawings.
  3. Finish: Color selected by Architect.
  4. Face Blade Arrangement: Horizontal.
  5. Core Construction: Integral or Removable.
  6. Mounting: Refer to Architectural ceiling plan for mounting type.
  7. Damper Type: Adjustable opposed blade.
  8. Accessories:
    - a. Front-blade gang operator.
- B. Fixed Face Grille:
1. Manufacturers:
    - a. Titus
    - b. Price Industries
    - c. Nailor Industries Inc.

- d. Tuttle & Bailey
- 2. Material: Steel or Aluminum as indicated on drawings.
- 3. Finish: Color selected by Architect.
- 4. Face Blade Arrangement: Horizontal.
- 5. Core Construction: Integral or Removable.
- 6. Mounting: Refer to Architectural ceiling plan for mounting type.
- 7. Damper Type: Adjustable opposed blade.

**2.02 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

- A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION**

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

**3.03 ADJUSTING**

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 233713.23**



**SECTION 234100**

**PARTICULATE AIR FILTRATION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Metal panel filters.
  - 2. Pleated panel filters.
  - 3. Front- or back-access filter frames.
  - 4. Side-access filter housings.
  - 5. Filter gauges.
  
- B. Related Requirements:
  - 1. Section 233416 "Centrifugal HVAC Fans" for customized fan and filter units.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  
- B. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
  - 2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Product test reports.
  
- B. Field quality-control reports.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

**1.05 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An NRTL.

**PART 2 - PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. ASHRAE Compliance:
  - 1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
  - 2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
  
- B. Comply with NFPA 90A and NFPA 90B.

- C. Comply with UL 900.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## **2.02 METAL PANEL FILTERS**

- A. Description: Factory-fabricated, self-supported, cleanable, all-metal, impingement-type, panel-type, permanent air filters with holding frames.
- B. Media: Minimum of three alternate layers of aluminum flat and herringbone or serpentine-crimp mesh screen.
  - 1. Non-oiled for grease removal application.
  - 2. Adhesive coating.
- C. Filter-Media Frame: Hot-dip galvanized steel, hinged, and with pull and retaining handles fastened to the media.
  - 1. Drain holes.
- D. Efficiency: Minimum 90 percent efficiency on particles 10 microns and larger.

## **2.03 PLEATED PANEL FILTERS**

- A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.
- B. Capacities and Characteristics:
  - 1. Face Size and Depth: Match manufacturer filter size requirements.
  - 2. Number of Filters, Wide by High: Match manufacturer filter requirements.
  - 3. Minimum Efficiency Reporting Value: MERV 13, with "Composite Average Particle Size Efficiency, Percent in Size Range, Micrometers" according to ASHRAE 52.2.
- C. Media: Interlaced glass or Cotton and synthetic fibers coated with nonflammable adhesive. Coat media with an antimicrobial agent.
  - 1. Separators shall be bonded to the media to maintain pleat configuration.
  - 2. Welded-wire grid shall be on downstream side to maintain pleat.
  - 3. Media shall be bonded to frame to prevent air bypass.
  - 4. Support members on upstream and downstream sides to maintain pleat spacing.
- D. Filter-Media Frame: Aluminized steel sealed or bonded to the media.

## **2.04 FRONT- OR BACK-ACCESS FILTER FRAMES**

- A. Description: Aluminum framing members with access for either upstream (front) or downstream (back) filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with filter installation or operation.
- B. Prefilters: Incorporate a separate track with spring clips, removable from front or back.
- C. Sealing: Factory-installed, positive-sealing device for each row of filters, to ensure seal between gasketed filter elements and to prevent bypass of unfiltered air.

**2.05 SIDE-ACCESS FILTER HOUSINGS**

- A. Description: Factory-assembled, side-service housings, constructed of aluminum, with flanges to connect to duct or casing system.
- B. Prefilters: Integral tracks to accommodate 2-inch- (50-mm-) thick, disposable or washable filters.
- C. Access Doors: Hinged, with continuous gaskets on perimeter and positive-locking devices, and arranged so filter cartridges can be loaded from either access door.
- D. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames and to prevent bypass of unfiltered air.

**2.06 FILTER GAUGES**

- A. Diaphragm-type gauge with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
  - 1. Diameter: 2 inches (50 mm).
  - 2. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5-Inch wg (125 Pa) or Less: 0- to 0.5-inch wg (0 to 125 Pa).
  - 3. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5- to 1.0-Inch wg (125 to 250 Pa) or Less: 0- to 1.0-inch wg (0 to 250 Pa).
  - 4. Scale Range for Filter Media Having a Recommended Final Resistance of 1.0- to 2.0-Inch wg (250 to 500 Pa) or Less: 0- to 2.0-inch wg (0 to 500 Pa).
  - 5. Scale Range for Filter Media Having a Recommended Final Resistance of 2.0- to 3.0-Inch wg (500 to 750 Pa) or Less: 0- to 3.0-inch wg (0 to 750 Pa).
  - 6. Scale Range for Filter Media Having a Recommended Final Resistance of 3.0- to 4.0-Inch wg (750 to 1000 Pa) or Less: 0- to 4.0-inch wg (0 to 1000 Pa).
- B. Manometer-Type Filter Gauge: Molded plastic, with epoxy-coated aluminum scale and logarithmic-curve tube gage with integral leveling gage, graduated to read from 0- to 3.0-inch wg (0 to 750 Pa), and accurate within 3 percent of the full-scale range.
- C. Accessories: Static-pressure tips, tubing, gauge connections, and mounting bracket.

**PART 3 - EXECUTION****3.01 INSTALLATION OF FILTERS**

- A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- B. Install filters in position to prevent passage of unfiltered air.
- C. Install filter gauge for each filter bank.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- E. Coordinate filter installations with duct and air-handling-unit installations.

**3.02 INSTALLATION OF FILTER GAUGES**

- A. Install filter gauge for each filter bank.

- B. Install filter-gauge, static-pressure taps upstream and downstream from filters. Install filter gauges on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gauges on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gauges.

### **3.03 CONTROL CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between pressure sensors and DDC system.
- C. Connect control wiring between controlled devices.

### **3.04 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
  - 1. Test for leakage of unfiltered air while system is operating.
- E. Air filter will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### **3.05 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

**END OF SECTION 234100**

**SECTION 237433****DEDICATED OUTDOOR-AIR UNITS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Prepare the following by or under the supervision of a qualified professional engineer:
    - a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
    - b. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For design of vibration isolation and wind restraints, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Unit fabrication and assembly details.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 3. Design Calculations:
    - a. Calculate requirements for selecting vibration isolators and wind restraints and for designing vibration isolation bases.
    - b. Indicate compliance with "Performance Requirements" article.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
  - 2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

- B. Seismic Qualification Certificates: For dedicated outdoor-air units, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Startup service reports.
- D. Sample Warranty: For special warranty.

#### **1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

#### **1.06 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fan Belts: One set[s] for each belt-driven fan.
  - 2. Filters: One set[s] for each unit.

#### **1.07 WARRANTY**

- A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Compressors: Five years from date of Substantial Completion.
  - 2. Warranty Period for Heat Exchangers: 10 years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Daikin is the basis of design
  - 2. Acceptable alternate manufacturers are Trane, Samsung, and Carrier

#### **2.02 PERFORMANCE REQUIREMENTS**

- A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation and wind restraints.
- C. Wind-Restraint Performance:
  - 1. Minimum 10 lb/sq. ft (48.8 kg/sq. m) multiplied by the maximum area of unit projected on a vertical plane that is normal to the wind direction and 45 degrees either side of normal.
- D. Cabinet Thermal Performance:
  - 1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
  - 2. Maximum Overall U-Value: 0.10 Btu/h x sq. ft. x deg F (0.57 W/sq. m x deg K).

3. Include effects of metal-to-metal contact and thermal bridges in the calculations.
- E. Cabinet Surface Condensation:
1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
  2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.
- F. Maximum Cabinet Leakage: 0.5 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.
- G. Cabinet Deflection Performance:
1. Walls and roof deflection shall be within 1/200 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
  2. Floor deflections shall be within 1/240 of the span considering the worst-case condition caused by the following:
    - a. Service personnel.
    - b. Internal components.
    - c. Design working pressure defined for the walls and roof.
- H. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics: See schedule on drawings for capacities and characteristics

## **2.03 CABINET**

- A. Construction: double wall.
- B. Exterior Casing Material: Galvanized steel with paint finish.
- C. Interior Casing Material: Galvanized steel.
- D. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.
- E. Base Rails: Galvanized-steel rails for mounting on roof curb or pad as indicated.
- F. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.
- G. Roof: Standing seam or membrane; sloped to drain water.
- H. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.
- I. Cabinet Insulation:
1. Type: Fibrous-glass duct lining complying with ASTM C1071, Type II or flexible elastomeric insulation complying with ASTM C534, Type II, sheet materials.
  2. Thickness: 1 inch (25 mm).
  3. Insulation Adhesive: Comply with ASTM C916, Type I.

4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.
- J. Condensate Drain Pans:
1. Shape: Rectangular, with 2 percent slope in at least two planes to direct water toward drain connection.
  2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.
    - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
    - b. Depth: A minimum of 2 inches (50 mm) deep.
  3. Configuration: Single wall.
  4. Configuration: Double wall, with space between walls filled with foam insulation and moisture-tight seal.
  5. Material: Galvanized-steel sheet with asphaltic waterproofing compound coating on pan top surface.
  6. Material: Stainless-steel sheet.
  7. Drain Connection:
    - a. Located on both ends of pan, at lowest point of pan.
    - b. Terminated with threaded nipple.
    - c. Minimum Connection Size: NPS 2 (DN 50).
  8. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- K. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.
- L. Roof Curb: Full-perimeter curb of sheet metal, minimum 14 inches (400 mm) high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing.
1. Comply with requirements in "The NRCA Roofing Manual."

## 2.04 SUPPLY FAN

- A. Forward-Curved Fan Type: Centrifugal; statically and dynamically balanced.
1. Fan Wheel Material: Coated steel, mounted on solid-steel shaft.
  2. Bearings: Self-aligning, permanently lubricated ball bearings.
- B. Plenum Fan Type: Single width, non-overloading, with backward-inclined or airfoil blades.
1. Fan Wheel Material: Aluminum; attached directly to motor shaft.
  2. Fan Wheel Drive and Arrangement: Direct drive, AMCA Arrangement 4.
  3. Fan panel and frame Material: Powder-coated steel, stainless steel, or aluminum.
  4. Fan Enclosure: Easily removable enclosure around rotating parts.
  5. Fan Balance: Precision balance fan below 0.08 inch/s (2.0 mm/s) at design speed with filter in.
- C. Service Factor for Belt Drive Applications: Multiple V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.5 service factor.
- D. Motors:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  2. Enclosure: Open dripproof.
  3. Enclosure Materials: Cast aluminum.
  4. Unusual Service Conditions:



- a. Altitude: 2,150 above sea level.
- 5. Efficiency: Premium efficient.
- 6. Service Factor: 1.15.

E. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with elastomeric isolators.

## **2.05 COOLING COILS**

- A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.
- B. Coil Casing Material: Manufacturer's standard material.
- C. Tube Material: Copper.
- D. Tube Header Material: Manufacturer's standard material.
- E. Fin Material: Manufacturer's standard material
- F. Fin and Tube Joints: Mechanical bond.
- G. Leak Test: Coils shall be leak tested with air underwater.
- H. Refrigerant Coil Capacity Reduction: Circuit coils for row control.
- I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.
- J. Coating: Corrosion-resistant coating after assembly.

## **2.06 REFRIGERATION SYSTEM**

- A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."
- B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.
- C. Compressors: Reciprocating or scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater.
- D. Refrigerant: R-410A.
  - 1. Classified as Safety Group A1 according to ASHRAE 34.
  - 2. Provide unit with operating charge of refrigerant.
- E. Refrigeration System Specialties:
  - 1. Expansion valve with replaceable thermostatic element.
  - 2. Refrigerant dryer.
  - 3. High-pressure switch.
  - 4. Low-pressure switch.
  - 5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
  - 6. Brass service valves installed in discharge and liquid lines.
- F. Capacity Control:
  - 1. Hot-gas bypass refrigerant control for capacity control with continuous dehumidification on a single compressor.

- G. Refrigerant condenser coils:
  - 1. Capacity Ratings: Complying with ASHRAE 33 and ARI 410 and coil bearing the ARI label.
  - 2. Tube Material: Copper.
  - 3. Fin Material: Copper.
  - 4. Fin and Tube Joint: Mechanical bond.
  - 5. Leak Test: Coils shall be leak tested with air underwater.
  - 6. Coating: Corrosion-resistant coating after assembly.
  
- H. Condenser Fan Assembly:
  - 1. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades.
  - 2. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - b. Motor Enclosure: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure.
    - c. Enclosure Materials: Cast aluminum.
    - d. Motor Bearings: Permanently lubricated bearings.
    - e. Unusual Service Conditions:
      - 1) Altitude: 2,150 above sea level.
    - f. Built-in overcurrent and thermal-overload protection.
    - g. Efficiency: Premium efficient.
  - 3. Fan Safety Guards: Steel with corrosion-resistant coating.
  
- I. Safety Controls:
  - 1. Compressor motor and condenser coil fan motor low ambient lockout.
  - 2. Overcurrent protection for compressor motor.

## **2.07 INDIRECT-FIRED GAS FURNACE HEATING**

- A. Furnace Assembly:
  - 1. Factory assembled, piped, and wired.
  - 2. Comply with requirements in NFPA 54, "National Fuel Gas Code," and ANSI Z21.47, "Gas-Fired Central Furnaces."
  - 3. AGA Approval: Designed and certified by and bearing label of AGA.
  
- B. Burners:
  - 1. Heat-Exchanger Material: Aluminized steel with stainless-steel inserts with a minimum thermal efficiency of 80 percent.
  - 2. Fuel: Natural gas.
  - 3. Ignition: Electronically controlled electric spark with flame sensor.
  - 4. High-Altitude Kit: For Project elevations more than 2000 feet (610 m) above sea level.
  
- C. Heat-Exchanger Drain Pan Material: Stainless steel.
  
- D. Venting: Gravity vented.
  
- E. Venting: Power vent with integral, motorized centrifugal fan interlocked with gas valve.
  
- F. Safety Controls:
  - 1. Gas Control Valve: Electronic modulating.
  - 2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

**2.08 CORROSION-RESISTANT COATINGS**

- A. Corrosion-Resistant Coating: Coat coils and fan guards with a corrosion-resistant coating capable of withstanding a 3,000-hour salt-spray test according to ASTM B117.
  - 1. Standards:
    - a. ASTM B117 for salt spray.
    - b. ASTM D2794 for minimum impact resistance of 100 in-lb (11.3 N-m).
    - c. ASTM D3359 for cross hatch adhesion of 5B.
  - 2. Application: Spray.
  - 3. Thickness: 1 mil.
  - 4. Gloss: Minimum gloss of 50 gloss units on a single angle 60-degree meter.
  - 5. UV Protection: Spray applied topcoat.

**2.09 OUTDOOR-AIR INTAKE HOOD**

- A. Type: Manufacturer's standard hood or louver.
- B. Materials: Match cabinet.
- C. Bird Screen: Comply with requirements in ASHRAE 62.1.
- D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

**2.10 FILTERS**

- A. Cleanable Filters: 2-inch- (50-mm-) thick, cleanable metal mesh.
- B. Disposable Panel Filters:
  - 1. Comply with NFPA 90A.
  - 2. Factory-fabricated, viscous-coated, flat-panel type.
  - 3. Thickness: 1 inch (25 mm).
  - 4. Minimum Arrestance: 80, according to ASHRAE 52.1.
  - 5. Minimum MERV: 6, according to ASHRAE 52.2.
  - 6. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
- C. Extended-Surface, Disposable Panel Filters:
  - 1. Comply with NFPA 90A.
  - 2. Factory-fabricated, dry, extended-surface type.
  - 3. Thickness: 2 inches (50 mm).
  - 4. Minimum Arrestance: 90, according to ASHRAE 52.1.
  - 5. Minimum MERV: 7, according to ASHRAE 52.2.
  - 6. Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
- D. Extended-Surface, Nonsupported-Media Filters:
  - 1. Comply with NFPA 90A.
  - 2. Factory-fabricated, dry, extended-surface, self-supporting type.
  - 3. Minimum Arrestance: 95, according to ASHRAE 52.1.
  - 4. Minimum MERV: 13, according to ASHRAE 52.2.
  - 5. Media: Fibrous material coated with an antimicrobial agent and constructed so individual pleats are maintained in tapered form by flexible internal supports under rated-airflow conditions.
- E. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Extended surface filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks with space for prefilter.

## **2.11 ELECTRICAL POWER CONNECTIONS**

- A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- B. Enclosure: NEMA 250, Type 4, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,
- C. Wiring: Numbered and color-coded to match wiring diagram.
- D. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- E. Power Interface: Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
- F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
  1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
  2. NEMA KS 1, heavy-duty, nonfusible switch.
  3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- G. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- I. Controls: Factory wire unit-mounted controls where indicated.
- J. Lights: Factory wire unit-mounted lights.
- K. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.
- L. Control Relays: Auxiliary and adjustable time-delay relays.

## **2.12 CONTROLS**

- A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
- B. Control Valves: Comply with requirements in Section 230923.11 "Control Valves."
- C. Control Wiring: Factory wire connection for controls' power supply.
- D. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

- E. Unit-Mounted Status Panel:
1. Cooling/Off/Heating Controls: Control operational mode.
  2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
  3. Status Lights:
    - a. Filter dirty.
    - b. Fan operating.
    - c. Cooling operating.
    - d. Heating operating.
    - e. Smoke alarm.
    - f. General alarm.
  4. Digital Numeric Display:
    - a. Outdoor airflow.
    - b. Supply airflow.
    - c. Outdoor dry-bulb temperature.
    - d. Outdoor dew point temperature.
    - e. Space temperature.
    - f. Supply temperature.
    - g. Space relative humidity.
    - h. Space carbon dioxide level.
- F. Control Dampers:
1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
  2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. (33 L/s per sq. m) at a static-pressure differential of 4.0 inches water column (1000 Pa) when a torque of 5 in./lb per sq. ft. (30.1 N-m per sq. m) is applied to the damper jackshaft.
  3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
  4. Damper Label: Bear the AMCA seal for both air leakage and performance.
  5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two airstreams. For other applications, use an opposed-blade configuration.
  6. Damper Frame Material: Extruded aluminum.
  7. Blade Type: hollow-shaped airfoil.
  8. Blade Material: Extruded aluminum.
  9. Maximum Blade Width: 6 inches (150 mm).
  10. Maximum Blade Length: 48 inches (1200 mm).
  11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
  12. Bearings: Thrust bearings for vertical blade axles.
  13. Airflow Measurement:
    - a. Monitoring System: Complete and functioning system of airflow monitoring as an integral part of the damper assembly where indicated.
    - b. Remote Monitoring Signal: 0-10 volt or 4-20 mA scaled signal.
    - c. Accuracy of flow measurement: Within 5 percent of the actual flow rate between the range of the scheduled minimum and maximum airflow. For units with a large range between minimum and maximum airflow, configure the damper sections and flow measurement assembly as necessary to comply with accuracy.
    - d. Straightening Device: Integral to the flow measurement assembly if required to achieve the specified accuracy as installed.
    - e. Flow measuring device: Suitable for operation in untreated and unfiltered outdoor air. If necessary, include temperature and altitude compensation and correction to maintain the accuracy.

- G. Damper Operators:
1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
  2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
  3. Maximum Operating Time: Open or close damper 90 degrees in 60 seconds.
  4. Adjustable Stops: For both maximum and minimum positions.
  5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
  6. Spring-return operator to fail-safe; either closed or open as required by application.
  7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
  8. Position feedback Signal: For remote monitoring of damper position.
  9. Coupling: V-bolt and V-shaped, toothed cradle.
  10. Circuitry: Electronic overload or digital rotation-sensing circuitry.
- H. Refrigeration System Controls:
1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb (65 kJ/kg) of dry air or outdoor-air temperature is less than 60 deg F (15 deg C).
  2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 60 deg F (15 deg C).
  3. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.
- I. Furnace Controls:
1. Factory-mounted sensor in supply outlet with sensor adjustment located in control panel to modulate gas furnace burner to maintain space temperature.
  2. Wall-mounted, space-temperature sensor with temperature adjustment to modulate gas furnace burner to maintain space temperature.
  3. Remote Setback: Adjustable room thermostat selected by timer, cycles supply fan and gas furnace burner to maintain space temperature.
  4. Staged Burner Control: Four steps of control.
  5. Electromechanical or Electronic Burner Control: 20 to 100 percent modulation of the firing rate; 10 to 100 percent with dual-furnace units.
- J. Damper Controls: Space pressure sensor modulates outdoor- and return-air dampers to maintain a positive pressure in space at a minimum of 0.05 inch wg (12.4 Pa) with respect to outdoor reference.
- K. Integral Smoke Alarm: Smoke detector installed in return air.
- L. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC." Links shall include the following:
1. Start/stop interface relay, and relay to notify DDC temperature-control system alarm condition.
  2. Hardware interface or additional sensors for the following:
    - a. Room temperature.
    - b. Discharge-air temperature.
    - c. Refrigeration system operating.
    - d. Furnace operating.
    - e. Constant and variable motor loads.
    - f. Variable-frequency-controller operation.

- g. Cooling load.
  - h. Economizer cycles.
  - i. Air-distribution static pressure and ventilation-air volumes.
- M. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display unit status and alarms.
  - 1. Hardwired Points:
    - a. Monitoring: On-off status, common trouble alarm.
    - b. Control: On-off operation, space temperature set-point adjustment supply temperature set-point adjustment space humidity set-point adjustment space pressure set-point adjustment.
  - 2. LonTalk communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC system for HVAC.

### 2.13 ACCESSORIES

- A. Service Lights and Switch: Factory installed in each accessible section with weatherproof cover. Factory wire lights to a single-point field connection.
- B. Duplex Receptacle: Factory mounted in unit supply-fan section, with 20 amp 120 V GFI duplex receptacle and weatherproof cover.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
  - 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
  - 2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.
  - 3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
- C. Restrained Curb Support: Install restrained vibration isolation roof-curb rails on roof structure according to "The NRCA Roofing Manual."
- D. Equipment Mounting:

1. Install air units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations.
  2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- F. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- G. Install 3000-psi (20.7-MPa), compressive-strength (28-day) concrete base inside roof curb, 4 inches (100 mm) thick. Concrete and reinforcement are specified with concrete.
- H. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- I. Install separate devices furnished by manufacturer and not factory installed.
- J. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- K. Install drain pipes from unit drain pans to sanitary drain.
1. Drain Piping: Drawn-temper copper water tubing complying with ASTM B88, Type L (ASTM B88M, Type B), with soldered joints.
  2. Drain Piping: Schedule 40 PVC pipe complying with ASTM D1785, with solvent-welded fittings.
  3. Pipe Size: Same size as condensate drain pan connection.

### **3.03 CONNECTIONS**

- A. Where installing piping adjacent to units, allow space for service and maintenance.
- B. Gas Piping Connections:
1. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
  2. Install AGA-approved flexible connectors.
- C. Duct Connections:
1. Comply with requirements in Section 233113 "Metal Ducts."
  2. Drawings indicate the general arrangement of ducts.
  3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."
- D. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
1. Install electrical devices furnished by unit manufacturer but not factory mounted.

### **3.04 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
  2. Inspect units for visible damage to furnace combustion chamber.



3. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
    - a. Measure gas pressure at manifold.
    - b. Measure combustion-air temperature at inlet to combustion chamber.
    - c. Measure flue-gas temperature at furnace discharge.
    - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
  4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
    - a. High-limit heat exchanger.
    - b. Alarms.
  5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
  6. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
    - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    - c. Condenser coil entering-air dry-bulb temperature.
    - d. Condenser coil leaving-air dry-bulb temperature.
  7. Simulate maximum cooling demand and inspect the following:
    - a. Compressor refrigerant suction and hot-gas pressures.
    - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
  8. Inspect casing insulation for integrity, moisture content, and adhesion.
  9. Verify that clearances have been provided for servicing.
  10. Verify that controls are connected and operable.
  11. Verify that filters are installed.
  12. Clean coils and inspect for construction debris.
  13. Clean furnace flue and inspect for construction debris.
  14. Inspect operation of power vents.
  15. Purge gas line.
  16. Inspect and adjust vibration isolators and seismic restraints.
  17. Verify bearing lubrication.
  18. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  19. Adjust fan belts to proper alignment and tension.
  20. Start unit.
  21. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
  22. Operate unit for run-in period.
  23. Calibrate controls.
  24. Adjust and inspect high-temperature limits.
  25. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
  26. Verify operational sequence of controls.
  27. Measure and record the following airflows. Plot fan volumes on fan curve.
    - a. Supply-air volume.
    - b. Return-air flow.
    - c. Outdoor-air flow.
- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

**3.05 ADJUSTING**

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

**3.06 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

**END OF SECTION 237433**

**SECTION 238126****SPLIT-SYSTEM AIR-CONDITIONERS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

**1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

**1.06 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set for each air-handling unit.
  - 2. Gaskets: One set for each access door.
  - 3. Fan Belts: One set for each air-handling unit fan.

**1.07 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

## 1.08 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

## 1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: Five year(s) from date of Substantial Completion.
    - c. For Labor: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Goodman.
  - 2. Trane.
  - 3. YORK.

### 2.02 INDOOR UNITS

- A. Concealed Evaporator-Fan Components:
  - 1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  - 2. Insulation: Faced, glass-fiber duct liner.
  - 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  - 4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
  - 5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
  - 6. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  8. Filters: Permanent, cleanable.
  9. Condensate Drain Pans:
    - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      - 1) Construction: Extend drain pan downstream from leaving face with a depth that complies with the North Carolina Building Code.
    - b. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    - c. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- B. Floor-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
    - a. Discharge Grille: Steel with surface-mounted frame or Welded steel bars forming a linear grille and welded into supporting panel.
    - b. Insulation: Faced, glass-fiber duct liner.
    - c. Drain Pans: Galvanized steel, with connection for drain; insulated.
  2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
  4. Fan: Direct drive, centrifugal].
  5. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
  6. Air Filtration Section:
    - a. General Requirements for Air Filtration Section:
      - 1) Comply with NFPA 90A.
      - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
      - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
    - b. Disposable Panel Filters:
      - 1) Factory-fabricated, viscous-coated, flat-panel type.
      - 2) Thickness: 1 inch (25 mm).
      - 3) Merv according to ASHRAE 52.2: 5.
      - 4) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.

## 2.03 OUTDOOR UNITS

- A. Air-Cooled, Compressor-Condenser Components:
1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
  2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
    - a. Compressor Type: Scroll.

- b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
  - c. Refrigerant Charge: R-410A.
  - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
  4. Fan: Aluminum-propeller type, directly connected to motor.
  5. Motor: Permanently lubricated, with integral thermal-overload protection.
  6. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
  7. Mounting Base: Polyethylene.

## **2.04 ACCESSORIES**

- A. Thermostat:
  1. Compressor time delay.
  2. 24-hour time control of system stop and start.
  3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  4. Fan-speed selection including auto setting.
  5. Controls that, except during defrost, prevent supplementary heat operation where the heat pump can provide the heating load.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
  1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### **3.02 CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-

system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

### **3.03 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

### **3.04 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### **3.05 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

**END OF SECTION 238126**

**SECTION 238129****VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section includes complete VRF HVAC system(s) including, but not limited to the following components to make a complete operating system(s) according to requirements indicated:
1. Indoor, concealed, ceiling-mounted units for ducting.
  2. Indoor, exposed, wall-mounted units.
  3. Indoor, recessed, ceiling-mounted units.
  4. Outdoor, air-source heat recovery units.
  5. Heat recovery control units.
  6. System controls.
  7. System refrigerant and oil.
  8. System condensate drain piping.
  9. System refrigerant piping.
  10. Metal hangers and supports.
  11. Metal framing systems.
  12. Fastener systems.
  13. Pipe stands.
  14. Miscellaneous support materials.
  15. Piping and tubing insulation.
  16. System control cable and raceways.

**1.02 DEFINITIONS**

- A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.
- B. Heat Recovery System Operation: System capable of operation with simultaneous heating and cooling zones that transfer heat between zones.
- C. HRCU: Heat Recovery Control Unit. HRCUs are used in heat recovery VRF HVAC systems to manage and control refrigerant between indoor units to provide simultaneous heating and cooling zones. "Heat Recovery Control Unit" is the term used by ASHRAE for what different manufacturers term as branch circuit controller, branch selector box, changeover box, flow selector unit, mode change unit, and other such terms.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- E. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- F. Three-Pipe System Design: One high pressure refrigerant vapor line, one low pressure refrigerant vapor line, and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One liquid line and refrigerant vapor line connect HRCUs to associated indoor units.
- G. VRF: Variable refrigerant flow.



**1.03 ACTION SUBMITTALS**

- A. Product data.
- B. Shop Drawings: For VRF HVAC systems.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 4. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
  - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For fully and partially exposed indoor units with factory finishes viewable by occupants.
- D. Delegated-Design Submittals:
  - 1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.
  - 2. Include design calculations with corresponding diagram of refrigerant piping and tubing sizing for each system installed.
  - 3. Include design calculations with corresponding floor plans indicating that refrigerant concentration limits are within allowable limits of ASHRAE 15 and governing codes.
  - 4. Include calculations showing that system travel distance for refrigerant piping and controls cabling are within horizontal and vertical travel distances set by manufacturer. Provide a comparison table for each system installed.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plans, elevations, sections, and details, drawn to scale, using input from installers of the items involved.
- B. Qualification Data:
  - 1. For Installer.
  - 2. For VRF HVAC system manufacturer.
  - 3. For VRF HVAC system provider.
- C. Product Certificates: For each type of product.
- D. Product test reports.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample warranties.

**1.05 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.
- B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

## 1.06 QUALITY ASSURANCE

- A. Factory-Authorized Service Representative Qualifications:
1. Authorized representative of, and trained by, VRF HVAC system manufacturer.
  2. In-place facility located within 150 miles of Project.
  3. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.
  4. Demonstrated past experience on five projects of similar complexity, scope, and value.
    - a. Each person assigned to Project shall have demonstrated past experience.
  5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
  6. Service and maintenance staff assigned to support Project during warranty period.
  7. Product parts inventory to support ongoing system operation for a period of not less than five years after Substantial Completion.
  8. VRF HVAC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.
1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
  2. Installer certification shall be valid and current for duration of Project.
  3. Retain copies of Installer certificates on-site and make available on request.
  4. Each person assigned to Project shall have demonstrated past experience.
    - a. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.
    - b. Demonstrated past experience on five projects of similar complexity, scope, and value.
- C. ISO Compliance: System equipment and components furnished by VRF HVAC system manufacturer shall be manufactured in an ISO 9001 and ISO 14001 facility.

## 1.07 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.
1. Warranty Period:
    - a. For Compressor: 10 year(s) from date of Substantial Completion.
    - b. For Parts, Including Controls: 10 year(s) from date of Substantial Completion.
    - c. For Labor: 10 year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Trane

2. Daikin
3. Carrier.

## 2.02 SYSTEM DESCRIPTION

- A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, HRCUs, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.
  1. Three-pipe system design.
  2. System(s) operation, heat recovery as indicated on Drawings.
  3. Each system with one refrigerant circuit shared by all indoor units connected to system.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. AHRI Compliance: System and equipment performance certified according to AHRI 1230 and products listed in AHRI directory.
- D. ASHRAE Compliance:
  1. ASHRAE 15: For safety code for mechanical refrigeration.
  2. ASHRAE 62.1: For indoor air quality.
  3. ASHRAE 135: For control network protocol with remote communication.
  4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.
- E. UL Compliance: Comply with UL 1995.

## 2.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design complete and operational VRF HVAC system(s) complying with requirements indicated.
  1. Provide system refrigerant calculations.
    - a. Refrigerant concentration limits shall be within allowable limits of ASHRAE 15 and governing codes.
    - b. Indicate compliance with manufacturer's maximum vertical and horizontal travel distances. Prepare a comparison table for each system showing calculated distances compared to manufacturer's maximum allowed distances.
  2. Include a mechanical ventilation system and gas detection system as required to comply with ASHRAE 15 and governing codes.
  3. System Refrigerant Piping and Tubing:
    - a. Arrangement: Arrange piping to interconnect indoor units, HRCUs, and outdoor unit(s) in compliance with manufacturer requirements and requirements indicated.
    - b. Routing: Conceal piping above ceilings and behind walls to maximum extent possible.
    - c. Sizing: Size piping system, using a software program acceptable to manufacturer, to provide performance requirements indicated. Consider requirements to accommodate future change requirements.
  4. System Controls:
    - a. Network arrangement.
    - b. Network interface with other building systems.
    - c. Product selection.
    - d. Sizing.
- B. Service Access:

1. Provide and document service access requirements.
  2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
  3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
  4. If less than full and unrestricted access is provided, locate components within an 18-inch (450-mm) reach of the finished assembly.
  5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
  6. Comply with OSHA regulations.
- C. System Design and Installation Requirements:
1. Design and install systems indicated according to manufacturer's recommendations and written instructions.
  2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.
- D. System Adaptability to Future Changes: Arrange and size system refrigerant piping to accommodate future changes to system without having to resize and replace existing refrigerant piping.
1. Future changes to system(s) indicated on Drawings.
  2. Each branch circuit shall accommodate addition of two indoor unit(s) with unit capacity equal to average indoor unit connected to the branch circuit.
  3. Each branch circuit shall accommodate deletion of one indoor unit(s) with unit capacity equal to average indoor unit connected to the branch circuit.
- E. Isolation of Equipment: Provide isolation valves to isolate each HRCU, indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.
- F. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
1. Not less than 60 percent.
  2. Not more than 115 percent.
  3. Range acceptable to manufacturer.
- G. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.
- H. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.
- I. Outdoor Conditions:
1. Suitable for outdoor ambient conditions encountered.
    - a. Design equipment and supports to withstand wind loads of governing code and ASCE/SEI 7.
    - b. Design equipment and supports to withstand snow and ice loads of governing code and ASCE/SEI 7.
    - c. Provide corrosion-resistant coating for components and supports where located in coastal or industrial climates that are known to be harmful to materials and finishes.
  2. Maximum System Operating Outdoor Temperature: See Drawings.
  3. Minimum System Operating Outdoor Temperature: See Drawings.

- J. Sound Performance: Sound levels generated by operating HVAC equipment shall be within requirements indicated.
  - 1. Indoor: Within design guidelines of "2015 ASHRAE HANDBOOK- HVAC Applications."
  - 2. Outdoor: Within ordinance of governing authorities.
- K. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.
- L. Capacities and Characteristics: As indicated on Drawings.

#### **2.04 INDOOR, CONCEALED, CEILING-MOUNTED UNITS FOR DUCTING**

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
- B. Cabinet:
  - 1. Material: Galvanized steel.
  - 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
  - 3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
  - 4. Mounting: Manufacturer-designed provisions for field installation.
  - 5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
  - 1. Coil Casing: Aluminum, galvanized, or stainless steel.
  - 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
  - 3. Coil Tubes: Copper, of diameter and thickness required by performance.
  - 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
  - 5. Unit Internal Tubing: Copper tubing with brazed joints.
  - 6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  - 7. Field Piping Connections: Manufacturer's standard.
  - 8. Factory Charge: Dehydrated air or nitrogen.
  - 9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
  - 1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
  - 2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
  - 3. Field Piping Connection: Non-ferrous material with threaded NPT.
- E. Fan and Motor Assembly:
  - 1. Fan(s):
    - a. Direct-drive arrangement.
    - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    - c. Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
    - d. Wheels statically and dynamically balanced.
  - 2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
  - 3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
  - 4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.

5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
  2. Efficiency: ASHRAE 52.2, MERV 11.
  3. Media:
    - a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
    - b. Washable: Manufacturer's standard filter with antimicrobial treatment.
- G. Unit Accessories:
1. Outdoor Air Ventilation Kit: Connection, motorized damper, and control sized to allow sequence of operation indicated on Drawings.
  2. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
  3. .
- H. Unit Controls:
1. Enclosure: Metal, suitable for indoor locations.
  2. Factory-Installed Controller: Configurable digital control.
  3. Factory-Installed Sensors:
    - a. Unit inlet air temperature.
    - b. Coil entering refrigerant temperature.
    - c. Coil leaving refrigerant temperature.
  4. Field-Customizable I/O Capability:
    - a. Analog Inputs: Three for use in customizable control strategies.
    - b. Digital Inputs: Three for use in customizable control strategies.
    - c. Digital Outputs: Three for use in customizable control strategies.
  5. Features and Functions:
    - a. Self-diagnostics.
    - b. Time delay.
    - c. Auto-restart.
    - d. External static pressure control.
    - e. Auto operation mode.
    - f. Manual operation mode.
    - g. Filter service notification.
    - h. Power consumption display.
    - i. Drain assembly high water level safety shutdown and notification.
    - j. Run test switch.
  6. Communication: Network communication with other indoor and outdoor units.
  7. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  8. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- I. Unit Electrical:
1. Enclosure: Metal, suitable for indoor locations.
  2. Field Connection: Single point connection to power unit and integral controls.
  3. Disconnecting Means: Factory-mounted circuit breaker or switch.
  4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
  5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  6. Raceways: Enclose line voltage wiring in metal raceways.

**2.05 INDOOR, EXPOSED, WALL-MOUNTED UNITS**

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
- B. Cabinet:
  - 1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
  - 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
  - 3. Mounting: Manufacturer-designed provisions for field installation.
  - 4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
  - 1. Coil Casing: Aluminum, galvanized, or stainless steel.
  - 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
  - 3. Coil Tubes: Copper, of diameter and thickness required by performance.
  - 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
  - 5. Unit Internal Tubing: Copper tubing with brazed joints.
  - 6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  - 7. Field Piping Connections: Manufacturer's standard.
  - 8. Factory Charge: Dehydrated air or nitrogen.
  - 9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
  - 1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
  - 2. Condensate Removal: Gravity.
    - a. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.
  - 3. Field Piping Connection: Non-ferrous material with threaded NPT.
- E. Fan and Motor Assembly:
  - 1. Fan(s):
    - a. Direct-drive arrangement.
    - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    - d. Wheels statically and dynamically balanced.
  - 2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
  - 3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
  - 4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of at least 50 percent.
  - 5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
  - 1. Access: Front, to accommodate filter replacement without the need for tools.
  - 2. .
  - 3. Washable Media: Manufacturer's standard filter with antimicrobial treatment.
- G. Grille Assembly: Manufacturer's standard discharge grille with field-adjustable air pattern mounted in top or front face of unit cabinet.

- H. Unit Accessories:
  - 1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
  - 2. Condensate Pump: Integral reservoir and control with electrical power connection through unit power.
  
- I. Unit Controls:
  - 1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
  - 2. Factory-Installed Controller: Configurable digital control.
  - 3. Factory-Installed Sensors: Coil entering refrigerant temperature Coil leaving refrigerant temperature.
  - 4. Field-Customizable I/O Capability:
    - a. Analog Inputs: Three Insert number for use in customizable control strategies.
    - b. Digital Inputs: Three for use in customizable control strategies.
    - c. Digital Outputs: Three for use in customizable control strategies.
  - 5. Features and Functions: Self-diagnostics, time delay, auto-restart, external static pressure control, auto operation mode, manual operation mode, filter service notification, power consumption display, drain assembly high water level safety shutdown and notification, run test switch.
  - 6. Communication: Network communication with other indoor units and outdoor unit(s).
  - 7. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  - 8. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  
- J. Unit Electrical:
  - 1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
  - 2. Field Connection: Single point connection to power entire unit and integral controls.
  - 3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
  - 4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
  - 5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  - 6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

## **2.06 INDOOR, RECESSED, CEILING-MOUNTED UNITS**

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
  
- B. Cabinet:
  - 1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
  - 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
  - 3. Mounting: Manufacturer-designed provisions for field installation.
  - 4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
  
- C. DX Coil Assembly:
  - 1. Coil Casing: Aluminum, galvanized, or stainless steel.
  - 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
  - 3. Coil Tubes: Copper, of diameter and thickness required by performance.
  - 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.



5. Internal Tubing: Copper tubing with brazed joints.
  6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  7. Field Piping Connections: Manufacturer's standard.
  8. Factory Charge: Dehydrated air or nitrogen.
  9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
  2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
  3. Field Piping Connection: Non-ferrous material with threaded NPT.
- E. Fan and Motor Assembly:
1. Fan(s):
    - a. Direct-drive arrangement.
    - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    - d. Wheels statically and dynamically balanced.
  2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
  3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
  4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
  5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
1. Access: Bottom, to accommodate filter replacement without the need for tools.
  2. Efficiency: ASHRAE 52.2, MERV 11.
  3. Media:
    - a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
    - b. Washable: Manufacturer's standard filter with antimicrobial treatment.
- G. Discharge-Air Grille Assembly: Mounted in bottom of unit cabinet.
1. Discharge Pattern: One-, two-, three-, or four-way throw as indicated on Drawings.
    - a. Discharge Pattern Adjustment: Field-adjustable limits for up and down range of motion.
    - b. Discharge Pattern Closure: Ability to close individual discharges of units with multiple patterns.
  2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.
  3. Additional Branch Supply Duct Connection: Sheet metal knockout for optional connection to one additional supply branch duct.
- H. Return-Air Grille Assembly: Manufacturer's standard grille mounted in bottom of unit cabinet.
- I. Outdoor Air Ventilation Connection: Sheet metal knockout for optional connection to outdoor air ventilation duct.
- J. Unit Accessories:
1. Outdoor Air Ventilation Kit: Connection, motorized damper, and control to satisfy unit control sequence of operation indicated on Drawings.
  2. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.

- K. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
  2. Factory-Installed Controller: Configurable digital control.
  3. Factory-Installed Sensors: Coil entering refrigerant temperature Coil leaving refrigerant temperature.
  4. Field-Customizable I/O Capability:
    - a. Analog Inputs: Three for use in customizable control strategies.
    - b. Digital Inputs: Three for use in customizable control strategies.
    - c. Digital Outputs: Three for use in customizable control strategies.
  5. Features and Functions: Self-diagnostics, time delay, auto-restart, external static pressure control, auto operation mode, manual operation mode, filter service notification, power consumption display, drain assembly high water level safety shutdown and notification, run test switch
  6. Communication: Network communication with other indoor units and outdoor unit(s).
  7. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  8. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- L. Unit Electrical:
1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
  2. Field Connection: Single point connection to power entire unit and integral controls.
  3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
  4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
  5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

## 2.07 OUTDOOR, AIR-SOURCE HEAT RECOVERY UNITS

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
1. Specially designed for use in systems with simultaneous heating and cooling.
  2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
  3. All units installed shall be from the same product development generation.
- B. Cabinet:
1. Galvanized steel and coated with a corrosion-resistant finish.
    - a. Coating with documented salt spray test performance of 1000 hours according ASTM B117 surface scratch test (SST) procedure.
  2. Mounting: Manufacturer-designed provisions for field installation.
  3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. Compressor and Motor Assembly:
1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
  2. Protection: Integral protection against the following:
    - a. High refrigerant pressure.
    - b. Low oil level.
    - c. High oil temperature.
    - d. Thermal and overload.

- e. Voltage fluctuations.
  - f. Phase failure and phase reversal.
  - g. Short cycling.
  3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
  4. Vibration Control: Integral isolation to dampen vibration transmission.
  5. Oil management system to ensure safe and proper lubrication over entire operating range.
  6. Crankcase heaters with integral control to maintain safe operating temperature.
  7. Fusible plug.
- D. Condenser Coil Assembly:
1. Plate Fin Coils:
    - a. Casing: Aluminum, galvanized, or stainless steel.
    - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
    - c. Tubes: Copper, of diameter and thickness required by performance.
  2. Aluminum Microchannel Coils:
    - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
    - b. Single- or multiple-pass arrangement.
    - c. Construct fins, tubes, and header manifolds of aluminum alloy.
  3. Coating: Corrosion resistant.
  4. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- E. Condenser Fan and Motor Assembly:
1. Fan(s): Propeller type.
    - a. Direct-drive arrangement.
    - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
    - c. Statically and dynamically balanced.
  2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
  3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
  4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
  5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
  6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
  2. Factory-Installed Controller: Configurable digital control.
  3. Factory-Installed Sensors:
    - a. Refrigerant suction temperature.
    - b. Refrigerant discharge temperature.
    - c. Outdoor air temperature.
    - d. Refrigerant high pressure.
    - e. Refrigerant low pressure.
    - f. Oil level.

4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, power consumption display, run test switch equalize run time between multiple same components
  5. Communication: Network communication with indoor units and other outdoor unit(s).
  6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
  2. Field Connection: Single point connection to power entire unit and integral controls.
  3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
  4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
  5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.
- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevent corrosion when exposed to salt spray test for 1000 hours according ASTM B117.
- J. Unit Piping:
1. Unit Tubing: Copper tubing with brazed joints.
  2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  3. Field Piping Connections: Manufacturer's standard.
  4. Factory Charge: Dehydrated air or nitrogen.
  5. Testing: Factory pressure tested and verified to be without leaks.

## **2.08 HEAT RECOVERY CONTROL UNITS (HRCUs)**

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
1. Specially designed for use in systems with simultaneous heating and cooling.
  2. Systems shall consist of one unit, or multiple unit that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
- B. Cabinet:
1. Galvanized-steel construction.
  2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
  3. Mounting: Manufacturer-designed provisions for field installation.
  4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- D. Refrigeration Assemblies and Specialties:
1. Specially designed by manufacturer for type of VRF HVAC system being installed, either two or three pipe.

2. Each refrigerant branch circuit shall have refrigerant control valve(s) to control refrigerant flow.
3. Spares: Each heat recovery control unit shall include at least two branch circuit port(s) for future use.
4. Each system piping connection upstream of heat recovery unit shall be fitted with an isolation valve to allow for service to any heat recovery control unit in the system without interrupting operation of the system.
5. Each branch circuit connection shall be fitted with an isolation valve and capped service port to allow for service to any individual branch circuit without interrupting operation of the system.
  - a. If not available as an integral part of the heat recovery control unit, isolation valves shall be field installed adjacent to the unit pipe connection.

E. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors: .
4. Features and Functions: Self-diagnostics, fuse protection,.
5. Communication: Network communication with indoor units and outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

F. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

G. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

## 2.09 SYSTEM CONTROLS

A. General Requirements:

1. Network: Indoor units, HRCUs, and outdoor units shall include integral controls and connect through a manufacturer-selected control network.
2. Network Communication Protocol: open control communication between interconnected units. Control must communicate with LON based (iWorx design basis) building automation system
3. Integration with Building Automation System: ASHRAE 135, BACnet IP and certified by BACnet Testing Lab (BTL), including the following:
  - a. Ethernet connection via RJ-45 connectors and port with transmission at 100 Mbps or higher.

- b. Integration devices shall be connected to local uninterruptible power supply unit(s) to provide at least 5 minutes of battery backup operation after a power loss.
  - c. Integration shall include control monitoring scheduling change of value notifications.
4. Operator Interface:
- a. Operators shall interface with system and unit controls through the following:
    - 1) Operator interfaces integral to controllers.
    - 2) Owner-furnished PC connected to central controller(s).
    - 3) Web interface through web browser software.
    - 4) Integration with Building Automation System.
  - b. Users shall be capable of interface with controllers for control of indoor units to extent privileges are enabled. Control features available to users shall include the following:
    - 1) On/off control.
    - 2) Temperature set-point adjustment.
- B. VRF HVAC System Operator Software for PC:
- 1. Software offered by VRF HVAC system manufacturer shall provide system operators with ability to monitor and control VRF HVAC system(s) from a single dedicated Owner-furnished PC.
  - 2. Software shall provide operator with a graphic user interface to allow monitoring and control of multiple central controllers from a single device location through point-and-click mouse exchange.
  - 3. Plan views shall show building plans with location of indoor units and identification superimposed on plans.
  - 4. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
  - 5. Schedules operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Schedules daily, weekly, and annual events.
  - 6. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
  - 7. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
  - 8. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
  - 9. Supports Multiple Languages: English.
  - 10. Supports Imperial and Metric Temperature Units: Fahrenheit and Celsius.
  - 11. Displays service notifications and error codes.
  - 12. Monitors and displays up to 3000 item error history and 10000 item operation history for regular reporting and further archiving.
  - 13. Monitors and displays cumulative operating time of indoor units.
  - 14. Able to disable and enable operation of individual controllers for indoor units.
  - 15. Information displayed on individual controllers shall also be available for display.
  - 16. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.
- C. Central Controllers:
- 1. Centralized control for all indoor and outdoor units from a single central controller location.
    - a. Include multiple interconnected controllers as required.
  - 2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
  - 3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.

- a. Sets schedule for daily, weekly, and annual events.
  - b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.
4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
  5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
  6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
  7. Service diagnostics tool.
  8. Able to disable and enable operation of individual controllers for indoor units.
  9. Information displayed on individual controllers shall also be available for display through central controller.
  10. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.
  11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
  12. Operator interface through a backlit, high-resolution color display touch panel.
- D. Wired Controllers for Indoor Units:
1. Single controller capable of controlling multiple indoor units as group.
  2. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
  3. Multiple Language: English.
  4. Temperature Units: Fahrenheit and Celsius.
  5. On/Off: Turns indoor unit on or off.
  6. Hold: Hold operation settings until hold is released.
  7. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
  8. Temperature Display: 1-degree increments.
  9. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments
  10. Relative Humidity Display: 1 percent increments.
  11. Relative Humidity Set-Point: Adjustable in 1 percent increments
  12. Fan Speed Setting: Select between available options furnished with the unit.
  13. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
  14. Seven-day programmable operating schedule with up to eight events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
  15. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
  16. Occupancy detection.
  17. Service Notification Display: "Filter".
  18. Service Run Tests: Limit use by service personnel to troubleshoot operation.
  19. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
  20. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
  21. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
  22. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.
- E. Wireless Controllers for Indoor Units:
1. Wireless Communication:
    - a. Controller communicates to remote-mounted receiver that is wired to indoor unit(s).
      - 1) Include receivers with wireless controllers as required to complete installation.
      - 2) Low-voltage power required for receivers shall be powered through non-polar connections to indoor unit.

- b. One wireless controller shall be capable of communicating with one or multiple receivers to control one or multiple indoor units as a group.
- 2. Controller Battery Life: Three years.
- 3. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
- 4. Multiple Language: English.
- 5. Temperature Units: Fahrenheit and Celsius.
- 6. On/Off: Turns indoor unit on or off.
- 7. Hold: Hold operation settings until hold is released.
- 8. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
- 9. Temperature Display: 1-degree increments.
- 10. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments
- 11. Relative Humidity Display: 1 percent increments.
- 12. Relative Humidity Set-Point: Adjustable in 1 percent increments
- 13. Fan Speed Setting: Select between available options furnished with the unit.
- 14. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
- 15. Seven-day programmable operating schedule with up to eight events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
- 16. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
- 17. Occupancy detection.
- 18. Service Notification Display: "Filter".
- 19. Service Run Tests: Limit use by service personnel to troubleshoot operation.
- 20. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
- 21. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
- 22. Setting stored in non-volatile memory to ensure that settings are not lost if power is lost. Battery for date and time only.

## **2.10 SYSTEM REFRIGERANT AND OIL**

- A. Refrigerant:
  - 1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
  - 2. ASHRAE 34, Class A1 refrigerant classification.
  - 3. R-410a.
- B. Oil:
  - 1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

## **2.11 SYSTEM CONDENSATE DRAIN PIPING**

- A. If more than one material is listed, material selection is Contractor's option.
- B. Copper Tubing:
  - 1. Drawn-Temper Tubing: According to ASTM B88, Type M (ASTM B88M, Type C) or Type DWV according to ASTM B306.
  - 2. Wrought-Copper Fittings: ASME B16.22.
  - 3. Wrought-Copper Unions: ASME B16.22.
  - 4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux according to ASTM B813.
- C. PVC plastic pipe according to ASTM D1785, Schedule 40, with socket-type pipe fittings according to ASTM D2466 and solvent cement according to ASTM D2564, primer according to ASTM F656.



**2.12 SYSTEM REFRIGERANT PIPING**

- A. Comply with requirements in Section 232300 "Refrigerant Piping" for system piping requirements.
- B. Refrigerant Piping:
  - 1. Copper Tube: ASTM B280, Type ACR.
  - 2. Wrought-Copper Fittings: ASME B16.22.
  - 3. Brazing Filler Metals: AWS A5.8/A5.8M.
- C. Refrigerant Tubing Kits:
  - 1. Furnished by VRF HVAC system manufacturer.
  - 2. Factory-rolled and -bundled, soft-copper tubing with tubing termination fittings at each end.
  - 3. Standard one-piece length for connecting to indoor units.
  - 4. Pre-insulated with flexible elastomeric insulation of thickness to comply with governing energy code and sufficient to eliminate condensation.
  - 5. Factory Charge: Dehydrated air or nitrogen.
- D. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.
- E. Refrigerant Isolation Ball Valves:
  - 1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
  - 2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
  - 3. Valve Connections: Flare or sweat depending on size.

**2.13 METAL HANGERS AND SUPPORTS**

- A. Copper Tube Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized or copper-coated steel.
- B. Plastic Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, galvanized-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.

**2.14 METAL FRAMING SYSTEMS**

- A. MFMA Manufacturer Metal Framing Systems:
  - 1. Description: Shop- or field-fabricated, pipe-support assembly for supporting multiple parallel pipes.
  - 2. Standard: MFMA-4.
  - 3. Channels: Continuous slotted steel channel with inturned lips.
  - 4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel for use indoors and of stainless steel for use outdoors.

6. Metallic Coating for Use Indoors: Electroplated zinc hot-dip galvanized or mill galvanized.
7. Plastic Coating for Use Outdoors: PVC polyurethane epoxy or polyester.

## **2.15 FASTENER SYSTEMS**

- A. Powder-Actuated Fasteners: Threaded, zinc-coated steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  1. Indoor Applications: Zinc-coated steel.
  2. Outdoor Applications: Stainless steel.

## **2.16 PIPE STANDS**

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
  1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  2. Base: Plastic.
  3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
  1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  2. Bases: One or more; plastic.
  3. Vertical Members: Two or more protective-coated-steel channels.
  4. Horizontal Member: Protective-coated-steel channel.
  5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## **2.17 MISCELLANEOUS SUPPORT MATERIALS**

- A. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

- B. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- C. Threaded Rods: Continuously threaded. Zinc-plated steel or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar material as rods.

## 2.18 PIPING AND TUBING INSULATION

- A. Comply with requirements in Section 230719 "HVAC Piping Insulation" for system piping insulation requirements.
- B. Condensate Drain Piping and Tubing Insulation and Jacket Requirements:
  - 1. Flexible Elastomeric Insulation:
    - a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
    - b. Indoors: 3/4 inch (19 mm) thick.
    - c. Outdoors: 1 inch (25 mm) thick.
  - 2. Field-Applied Jacket:
    - a. Concealed: None required.
    - b. Indoors, Exposed to View: PVC, 20 mils (0.5 mm) thick.
    - c. Outdoors, Exposed to View: Aluminum, smooth, 0.020 inch (0.51 mm) thick.
- C. Refrigerant Tubing Insulation and Jacket Requirements:
  - 1. Flexible Elastomeric Insulation:
    - a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
    - b. Indoors: 1 inch (25 mm) thick.
    - c. Outdoors: 1 inch (25 mm) thick.
  - 2. Field-Applied Jacket:
    - a. Concealed: None required.
    - b. Indoors, Exposed to View: PVC, 20 mils (0.5 mm) thick.
    - c. Outdoors, Exposed to View: Aluminum, smooth, 0.020 inch (0.51 mm) thick.
- D. Flexible Elastomeric Insulation Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
- F. Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  - 4. Color: Aluminum.

## 2.19 SYSTEM CONTROL CABLE AND RACEWAYS

- A. Low-Voltage Control Cabling:
  - 1. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
- B. TIA-485A Network Cabling:
  - 1. Standard Cable: NFPA 70, Type CMG.
  - 2. Plenum-Rated Cable: NFPA 70, Type CMP.
- C. Ethernet Network Cabling: TIA-568-C.2 Category 6a cable with RJ-45 connectors.

**2.20 MATERIALS**

- A. Steel:
  - 1. ASTM A36/A36M for carbon structural steel.
  - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
  - 1. Manufacturer's standard grade for casing.
  - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.
- E. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.
  - 1. Standards:
    - a. ASTM B117 for salt spray.
    - b. ASTM D2794 for minimum impact resistance of 100 in-lb (11.3 N-m).
    - c. ASTM B3359 for cross-hatch adhesion of 5B.
  - 2. Application: Spray.
  - 3. Thickness: 1 mil (0.025 mm).
  - 4. Gloss: Minimum gloss of 60 on a 60-degree meter.

**2.21 SOURCE QUALITY CONTROL**

- A. Factory Tests: Test and inspect factory-assembled equipment.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports for historical record. Submit reports only if requested.

**PART 3 - EXECUTION****3.01 EQUIPMENT INSTALLATION**

- A. Clearance:
  - 1. Maintain manufacturer's recommended clearances for service and maintenance.
  - 2. Maintain clearances required by governing code.
- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
  - 1. Loose components shall be installed by system Installer under supervision of manufacturer's service representative.
- C. Indoor Unit Installations:
  - 1. Install units to be level and plumb while providing a neat and finished appearance.
  - 2. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch (10 mm).
  - 3. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
  - 4. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
  - 5. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

6. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
7. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch (13 mm).
8. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
9. Attachment: Install hardware for proper attachment to supported equipment.
10. Grouting: Place grout under equipment supports and make bearing surface smooth.

D. Outdoor Unit Installations:

1. Install units to be level and plumb while providing a neat and finished appearance.
2. Install outdoor units on support structures indicated on Drawings.
3. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases.
  - a. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
  - b. Grouting: Place grout under equipment supports and make bearing surface smooth.
4. Roof-Mounted Installations: Install outdoor units on equipment supports. Anchor units to supports with removable, stainless-steel fasteners.

### 3.02 GENERAL REQUIREMENTS FOR PIPING AND TUBING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping and tubing to permit valve servicing.
- F. Install piping and tubing at indicated slopes.
- G. Install piping and tubing free of sags.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping and tubing to allow application of insulation.
- J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors.
- L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors.

**3.03 CONDENSATE DRAIN PIPE AND TUBING INSTALLATION**

- A. General Requirements for Drain Piping and Tubing:
1. Install a union in piping at each threaded unit connection.
  2. Install an adjustable stainless-steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
  3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
    - a. Details indicated on Drawings.
    - b. Manufacturer's requirements.
    - c. Governing codes.
    - d. In the absence of requirements, comply with requirements of ASHRAE handbooks.
  4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
  5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.
- B. Gravity Drains:
1. Slope piping from unit connection toward drain termination at a constant slope of not less than two percent.
- C. Pumped Drains:
1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

**3.04 REFRIGERANT PIPING AND TUBING INSTALLATION**

- A. Refrigerant Tubing Kits:
1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
  2. Support tubing using hangers and supports indicated at intervals not to exceed 5 feet (1.5 m). Minimum rod size, 1/4 inch (6.4 mm).
  3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.
- B. Install refrigerant piping according to ASHRAE 15 and governing codes.
- C. Select system components with pressure rating equal to or greater than system operating pressure.
- D. Install piping as short and direct as possible, with a minimum number of joints and fittings.
- E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels if valves or equipment requiring maintenance is concealed behind finished surfaces.
- F. Install refrigerant piping and tubing in protective conduit where installed belowground.
- G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.

- H. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:
  - 1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- I. When brazing, remove or protect components that could be damaged by heat.
- J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.
- K. Joint Construction:
  - 1. Ream ends of tubes and remove burrs.
  - 2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
  - 3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
    - a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
    - b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

### **3.05 PIPE AND TUBING INSULATION INSTALLATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Installation to maintain a continuous vapor barrier.
- B. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  - 2. When preformed valve covers are unavailable, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- E. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

**3.06 DUCT, ACCESSORIES, AND AIR OUTLETS INSTALLATION**

- A. Where installing ductwork adjacent to equipment, allow space for service and maintenance.
- B. Comply with requirements for metal ducts specified in Section 233113 "Metal Ducts."
- C. Comply with requirements for air duct accessories specified in Section 233300 "Air Duct Accessories."
- D. Comply with requirements for flexible ducts specified in Section 233346 "Flexible Ducts."
- E. Comply with requirements for air diffusers specified in Section 233713.13 "Air Diffusers."
- F. Comply with requirements for registers and grilles specified in Section 233713.23 "Registers and Grilles."

**3.07 SOFTWARE**

- A. Cybersecurity:
  - 1. Software:
    - a. Coordinate security requirements with IT department.
    - b. Ensure that latest stable software release is installed and properly operating.
    - c. Disable or change default passwords to password using a combination of uppercase and lower letters, numbers, and symbols at least eight characters in length. Record passwords and turn over to party responsible for system operation and administration.
  - 2. Hardware:
    - a. Coordinate location and access requirements with IT department.
    - b. Enable highest level of wireless encryption that is compatible with Owner's ICT network.
    - c. Disable dual network connections.

**3.08 FIRESTOPPING**

- A. Comply with TIA-569-D, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping" Chapter.

**3.09 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections with the assistance of manufacturer's service representative:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Refrigerant Tubing Positive Pressure Testing:
  - 1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.



2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.2 times VRF HVAC system operating pressure, but not less than 600 psig (4137 kPa), using dry nitrogen.
  3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
  4. Prepare test report to record the following information for each test:
    - a. Name of person starting test, company name, phone number, and e-mail address.
    - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
    - c. Detailed description of extent of tubing tested.
    - d. Date and time at start of test.
    - e. Test pressure at start of test.
    - f. Outdoor temperature at start of test.
    - g. Name of person ending test, company name, phone number, and e-mail address.
    - h. Date and time at end of test.
    - i. Test pressure at end of test.
    - j. Outdoor temperature at end of test.
    - k. Remarks:
  5. Submit test reports for Project record.
- C. Refrigerant Tubing Evacuation Testing:
1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
  2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
  3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
  4. Prepare test report to record the following information for each test:
    - a. Name of person starting test, company name, phone number, and e-mail address.
    - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
    - c. Detailed description of extent of tubing tested.
    - d. Date and time at start of test.
    - e. Test pressure at start of test.
    - f. Outdoor temperature at start of test.
    - g. Name of person ending test, company name, phone number, and e-mail address.
    - h. Date and time at end of test.
    - i. Test pressure at end of test.
    - j. Outdoor temperature at end of test.
    - k. Remarks:
  5. Submit test reports for Project record.
  6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.
- D. System Refrigerant Charge:
1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
  2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
  3. System refrigerant charging shall be witnessed by system manufacturer's representative.
  4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.
- E. Products will be considered defective if they do not pass tests and inspections.

- F. Prepare test and inspection reports.

### **3.10 STARTUP SERVICE**

- A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.
  - 1. Service representative shall be an employee or a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
  - 2. Complete startup service of each separate system.
  - 3. Complete system startup service according to manufacturer's written instructions.
- B. Startup checks shall include, but not be limited to, the following:
  - 1. Check control communications of equipment and each operating component in system(s).
  - 2. Check each indoor unit's response to demand for cooling and heating.
  - 3. Check each indoor unit's response to changes in airflow settings.
  - 4. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.
  - 5. Check sound levels of each indoor and outdoor unit.
- C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.
  - 1. Installer shall correct deficiencies found during startup service for reverification.
- D. System Operation Report:
  - 1. After completion of startup service, manufacturer shall issue a report for each separate system.
  - 2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
  - 3. Manufacturer shall electronically record not less than two hours of continuous operation of each system and submit with report for historical reference.
    - a. All available system operating parameters shall be included in the information submitted.
- E. Witness:
  - 1. Invite Owner to witness startup service procedures.
  - 2. Provide written notice not less than 20 business days before start of startup service.

### **3.11 ADJUSTING**

- A. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.
- C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.
- D. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

**3.12 SOFTWARE SERVICE AGREEMENT**

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

**3.13 DEMONSTRATION**

- A. Engage a VRF HVAC system manufacturer's employed training instructor or factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

**END OF SECTION 238129**

**SECTION 238239.19****WALL AND CEILING UNIT HEATERS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include details of anchorages and attachments to structure and to supported equipment.
  - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
  - 5. Wiring Diagrams: Power, signal, and control wiring.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS****2.01 MANUFACTURERS**

- A. Qmark
- B. Markel Products
- C. Trane

**2.02 DESCRIPTION**

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

**2.03 CABINET**

- A. Front Panel: Stamped-steel louver or Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

**2.04 COIL**

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection.

**2.05 FAN AND MOTOR**

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated.

**2.06 CONTROLS**

- A. Controls: Unit-mounted thermostat or wall mounted thermostat as indicated on drawings.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

**2.07 CAPACITIES AND CHARACTERISTICS**

- A. This project has multiple types and configurations of heaters. Refer to drawings for exact specifications.

**PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION**

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.

- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

**END OF SECTION 238239.19**

**SECTION 26-05-00**  
**COMMON WORK RESULTS FOR ELECTRICAL**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Electrical equipment coordination and installation.
  2. Sleeves for raceways and cables.
  3. Sleeve seals.
  4. Grout.
  5. Common electrical installation requirements.

**1.03 DEFINITIONS**

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

**1.04 SUBMITTALS**

- A. Product Data: For sleeve seals.

**1.05 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  3. To allow right of way for piping and conduit installed at required slope.
  4. All connecting raceways, cables, wireways, cable trays, and busways shall be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- D. Coordinate sleeve selection and application with selection and application of firestopping.
- E. All work shall be tested and inspected. Coordinate testing dates and requirements with the architect and engineer. All tests and inspections shall be scheduled in advance. It is the responsibility of the electrical contractor to notify the Electrical Inspector to schedule required inspections including rough-in, above ceiling and final inspections.
- F. Division of Work: Refer to detail on the drawings for division of work:
1. All individual motor starters and drives for mechanical equipment shall be furnished and installed under Mechanical Division.
  2. Under Electrical Division, power wiring shall be provided up to a termination point consisting of a junction box, trough starter, VFD, or disconnect switch. Under Division 26, line side terminations shall be provided.
  3. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Mechanical Division.

- G. Provide detailed installation and phasing coordination drawings, including proposed schedule for each deck. Coordination/phasing drawings shall indicate which parking spaces and floors will be affected by the lighting safety upgrades.

## **PART 2 - PRODUCTS**

### **2.01 SLEEVES FOR RACEWAYS AND CABLES**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

### **2.02 SLEEVE SEALS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### **2.03 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## **PART 3 - EXECUTION**

### **3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. Comply with NECA 1.
- B. Comply with NFPA 70E.
- C. Comply with the Energy Independence and Security Act, effective date January 1, 2009.
- D. Comply with the latest edition (2020) of the National Electrical Code, all North Carolina State Building Codes, and local Electrical Inspector and Fire Alarm Inspector.
- E. Testing: Provide testing for the following systems:
  - 1. Lighting controls
  - 2. Fire Alarm
- F. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.



- G. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- H. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- I. Right of Way: Give to piping systems installed at a required slope.

### **3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- J. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- K. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### **3.03 SLEEVE-SEAL INSTALLATION**

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

**END OF SECTION**

**SECTION 260519**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Copper building wire rated 600 V or less.
  2. Metal-clad cable, Type MC, rated 600 V or less.
  3. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

**1.03 DEFINITIONS**

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

**1.04 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Member company of NETA.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

**PART 2 - PRODUCTS****2.01 COPPER BUILDING WIRE**

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Belden Inc.
  2. Southwire Company.
  3. WESCO.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
  2. RoHS compliant.
  3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
  - 1. Type NM: Comply with UL 83 and UL 719.
  - 2. Type RHH and Type RHW-2: Comply with UL 44.
  - 3. Type USE-2 and Type SE: Comply with UL 854.
  - 4. Type THHN and Type THWN-2: Comply with UL 83.
  - 5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  - 6. Type XHHW-2: Comply with UL 44.

## 2.02 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. 3M Electrical Products.
  - 2. Hubbell Power Systems, Inc.
  - 3. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
  - 1. Material: Copper.
  - 2. Type: One hole with standard barrels.
  - 3. Termination: Compression.

## PART 3 - EXECUTION

### 3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

### 3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.

- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. VFC Output Circuits: Type XHHW-2 in metal conduit.

### **3.03 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### **3.04 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

### **3.05 IDENTIFICATION**

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### **3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.07 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

### **3.08 FIELD QUALITY CONTROL**

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

**END OF SECTION**

**SECTION 260526  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section includes grounding and bonding systems and equipment.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

**PART 2 - PRODUCTS****2.01 SYSTEM DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

**2.02 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. ERICO; a brand of nVent.
  2. Siemens Industry, Inc., Energy Management Division.
  3. Thomas & Betts Corporation; A Member of the ABB Group.

**2.03 CONDUCTORS**

- A. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
  2. Stranded Conductors: ASTM B 8.
  3. Tinned Conductors: ASTM B 33.
  4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, **1/4 inch (6 mm)** in diameter.
  5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
  7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
- B. Grounding Bus: Predrilled rectangular bars of annealed copper, **1/4 by 4 inches (6.3 by 100 mm)** in cross section, with **9/32-inch (7.14-mm)** holes spaced **1-1/8 inches (28 mm)** apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

## 2.04 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- H. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- I. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- K. Straps: Solid copper, copper lugs. Rated for 600 A.
- L. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.
- M. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- N. Water Pipe Clamps:
  - 1. Mechanical type, two pieces with stainless-steel bolts.
    - a. Material: Tin-plated aluminum.
    - b. Listed for direct burial.
  - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

## 2.05 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; **3/4 inch by 10 feet (19 mm by 3 m)**.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
  - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least **48 inches (1200 mm)** long.
  - 2. Backfill Material: Electrode manufacturer's recommended material.
- C. Ground Plates: **1/4 inch (6 mm)** thick, hot-dip galvanized.

## PART 3 - EXECUTION

### 3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least **24 inches (600 mm)** below grade.
  - 2. Duct-Bank Grounding Conductor: Bury **12 inches (300 mm)** above duct bank when indicated as part of duct-bank installation.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers **2 inches (50 mm)** minimum from wall, **6 inches (150 mm)** above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- D. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.02 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.03 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.



- E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.04 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are **2 inches (50 mm)** below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. Use exothermic welds for all below-grade connections.
  - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 feet (18 m)** apart.
- G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
  - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
  - 2. Bury ground ring not less than **24 inches (600 mm)** from building's foundation.

- H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of **20 feet (6 m)** of bare copper conductor not smaller than No. 4 AWG.
  - 1. If concrete foundation is less than **20 feet (6 m)** long, coil excess conductor within base of foundation.
  - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- I. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

### **3.05 FIELD QUALITY CONTROL**

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  - 2. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION**

**SECTION 260529  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Steel slotted support systems.
  2. Aluminum slotted support systems.
  3. Nonmetallic slotted support systems.
  4. Conduit and cable support devices.
  5. Support for conductors in vertical conduit.
  6. Structural steel for fabricated supports and restraints.
  7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
  8. Fabricated metal equipment support assemblies.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Slotted support systems, hardware, and accessories.
    - b. Clamps.
    - c. Hangers.
    - d. Sockets.
    - e. Eye nuts.
    - f. Fasteners.
    - g. Anchors.
    - h. Saddles.
    - i. Brackets.
  2. Include rated capacities and furnished specialties and accessories.
  3. Hangers. Include product data for components.
  4. Slotted support systems.
  5. Equipment supports.
  6. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- B. Delegated-Design Submittal: For hangers and supports for electrical systems.
1. Include design calculations and details of hangers.

**1.04 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M.
  2. AWS D1.2/D1.2M.

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame Rating: Class 1.
  - 2. Self-extinguishing according to ASTM D 635.

**2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum **13/32-inch-****(10-mm-)** diameter holes at a maximum of **8 inches (200 mm)** o.c. in at least one surface.
  - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. **B-line, an Eaton business.**
    - b. **Thomas & Betts Corporation; A Member of the ABB Group.**
    - c. **Unistrut; Part of Atkore International.**
  - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
  - 4. Channel Width: Selected for applicable load criteria.
  - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) **B-line, an Eaton business.**
      - 2) **Hilti, Inc.**

- 3) MKT Fastening, LLC.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

### 2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

## PART 3 - EXECUTION

### 3.01 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA 1.
  2. NECA 101
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be **1/4 inch (6 mm)** in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.

### 3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **200 lb (90 kg)**.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
  5. To Light Steel: Sheet metal screws.

6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than **4 inches (100 mm)** larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use **3000-psi (20.7-MPa)**, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils (0.05 mm)**.

B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**

**SECTION 260533  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Metal conduits and fittings.
  2. Nonmetallic conduits and fittings.
  3. Metal wireways and auxiliary gutters.
  4. Nonmetal wireways and auxiliary gutters.
  5. Surface raceways.
  6. Boxes, enclosures, and cabinets.

**1.03 DEFINITIONS**

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

**1.04 ACTION SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Source quality-control reports.

**PART 2 - PRODUCTS****2.01 METAL CONDUITS AND FITTINGS**

- A. Metal Conduit:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit; a part of Atkore International.
    - b. Southwire Company.
    - c. Thomas & Betts Corporation; A Member of the ABB Group.
  2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
  3. GRC: Comply with ANSI C80.1 and UL 6.
  4. ARC: Comply with ANSI C80.5 and UL 6A.

5. IMC: Comply with ANSI C80.6 and UL 1242.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Allied Tube & Conduit; a part of Atkore International.
  - b. Southwire Company.
  - c. Thomas & Betts Corporation; A Member of the ABB Group.
2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Fittings for EMT:
  - a. Material: Steel.
  - b. Type: compression.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.02 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Electri-Flex Company.
  - b. RACO; Hubbell.
  - c. Thomas & Betts Corporation; A Member of the ABB Group.
2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
3. Fiberglass:
  - a. Comply with NEMA TC 14.
  - b. Comply with UL 2515 for aboveground raceways.
  - c. Comply with UL 2420 for belowground raceways.
4. ENT: Comply with NEMA TC 13 and UL 1653.
5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
6. LFNC: Comply with UL 1660.
7. Rigid HDPE: Comply with UL 651A.
8. Continuous HDPE: Comply with UL 651A.
9. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
10. RTRC: Comply with UL 2515A and NEMA TC 14.



- B. Nonmetallic Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Electri-Flex Company.
    - b. RACO; Hubbell.
    - c. Thomas & Betts Corporation; A Member of the ABB Group.
  2. Fittings, General: Listed and labeled for type of conduit, location, and use.
  3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
    - a. Fittings for LFNC: Comply with UL 514B.
  4. Solvents and Adhesives: As recommended by conduit manufacturer.

### **2.03 METAL WIREWAYS AND AUXILIARY GUTTERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. B-line, an Eaton business.
  2. Hoffman; a brand of nVent.
  3. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

### **2.04 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Allied Moulded Products, Inc.
  2. Hoffman; a brand of nVent.
  3. Lamson & Sessions.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.05 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hubbell Incorporated.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.

## 2.06 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Hubbell Incorporated; Wiring Device-Kellems.
  - 2. Thomas & Betts Corporation; A Member of the ABB Group.
  - 3. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
  2. Type: Fully adjustable.
  3. Shape: Rectangular.
  4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- M. Gangable boxes are allowed.
- N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Nonmetallic Enclosures: Fiberglass.
  3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- O. Cabinets:
1. NEMA 250, Type 1 Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  2. Hinged door in front cover with flush latch and concealed hinge.
  3. Key latch to match panelboards.
  4. Metal barriers to separate wiring of different systems and voltage.
  5. Accessory feet where required for freestanding equipment.
  6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### **PART 3 - EXECUTION**

#### **3.01 RACEWAY APPLICATION**

- A. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT.

3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: GRC.
  7. Boxes and Enclosures: NEMA 250, Type 1.
- B. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
  3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface raceways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

### 3.02 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from ENT to GRC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- V. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway

section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

- W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Conduit extending from interior to exterior of building.
  - 3. Conduit extending into pressurized duct and equipment.
  - 4. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 5. Where otherwise required by NFPA 70.
- Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and motors.
  - 1. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- DD. Locate boxes so that cover or plate will not span different building finishes.
- EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- GG. Set metal floor boxes level and flush with finished floor surface.
- HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### **3.03 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

**3.04 FIRESTOPPING**

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

**3.05 PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

**SECTION 260543**  
**UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
  2. Handholes and pull boxes.

**1.03 DEFINITION**

- A. RNC: Rigid nonmetallic conduit.

**1.04 SUBMITTALS**

- A. Product Data: For the following:
1. Duct-bank materials, including separators and miscellaneous components.
  2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  3. Accessories for manholes, handholes, pull boxes.
  4. Warning tape.
  5. Warning Planks.
- B. Shop Drawings for Factory-Fabricated Handholes and Pull Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
1. Duct entry provisions, including locations and duct sizes.
  2. Cover design.
  3. Grounding details.
  4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- C. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
  2. Drawings shall be signed and sealed by a qualified professional engineer.
- D. Product Certificates: For concrete and steel used in precast concrete manholes, pull boxes and handholes, comply with ASTM C 858.
- E. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.



- F. Qualification Data: For qualified professional engineer and testing agency.
- G. Source quality-control reports.
- H. Field quality-control reports.

#### **1.05 QUALITY ASSURANCE**

- A. Comply with IEEE C2.
- B. Comply with NFPA 70.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

#### **1.07 PROJECT CONDITIONS**

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Architect no fewer than five days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Architect's written permission.

#### **1.08 COORDINATION**

- A. Coordinate layout and installation of ducts, manholes, handholes, and pull boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and pull boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

#### **1.09 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

**PART 2 - PRODUCTS****2.01 CONDUIT**

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

**2.02 NONMETALLIC DUCTS AND DUCT ACCESSORIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems.
  - 2. ARNCO Corporation.
  - 3. Beck Manufacturing.
  - 4. Cantex, Inc.
  - 5. CertainTeed Corp.
  - 6. Condux International, Inc.
  - 7. DCX-CHOL Enterprises, Inc.; ELECSYS Division.
  - 8. Electri-Flex Company.
  - 9. IPEX Inc.
  - 10. Lamson & Sessions; Carlon Electrical Products.
  - 11. Manhattan Wire Products; a Belden company.
- B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type DB-60-PVC, ASTM F 512, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.
- C. Duct Accessories:
  - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and retained to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
  - 2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

**2.03 HANDHOLES AND PULL BOXES OTHER THAN PRECAST CONCRETE**

- A. Description: Comply with SCTE 77.
  - 1. Color: Gray.
  - 2. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
  - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
  - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 5. Cover Legend: Molded lettering,
    - a. "ELECTRIC" or "TELEPHONE" As indicated for each service.
    - b. Tier level number, indicating that the unit complies with the structural load test for that tier according to SCTE 77.
  - 6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, retained to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.

7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.
- B. Polymer Concrete Handholes and Pull Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two. Handholes and pull boxes shall comply with the requirements of SCTE 7 Tier loading according to application.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation.
    - d. NewBasis.

## **2.04 SOURCE QUALITY CONTROL**

- A. Nonconcrete Handhole and Pull Box Prototype Test: Test prototypes of manholes and pull boxes for compliance with SCTE 77. Strength tests shall be for specified Tier ratings of products supplied.
1. Testing Agency: Engage a qualified testing agency to evaluate nonconcrete handholes and pull boxes.
  2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## **PART 3 - EXECUTION**

### **3.01 CORROSION PROTECTION**

- A. Aluminum shall not be installed in contact with earth or concrete.

### **3.02 UNDERGROUND DUCT APPLICATION**

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.
- B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.
- C. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.
- D. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EB-20-PVC, in concrete-encased duct bank unless otherwise indicated.
- E. Underground Ducts Crossing Paved Paths and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

### **3.03 UNDERGROUND ENCLOSURE APPLICATION**

- A. Handholes and Pull Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-10 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 or Tier 22 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) "Light-Duty" vertical loading.

### **3.04 EARTHWORK**

- A. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures, patch, repair neatly to architects approval.

### **3.05 DUCT INSTALLATION**

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm), both horizontally and vertically, at other locations unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
  1. Begin change from regular spacing to end-bell spacing 10 ft. (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
  2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
  3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 ft. (3 m) outside the building wall without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

- H. Concrete-Encased Ducts: Support ducts on duct separators.
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 ft. (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
  3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
  4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
  7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
  8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
  9. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.
- I. Direct-Buried Duct Banks:
1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
  2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 ft. (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
  3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.

4. Install 6 " of clean backfill.
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction.
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
  - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
10. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

### **3.06 INSTALLATION OF HANDHOLES AND PULL BOXES OTHER THAN PRECAST CONCRETE**

- A. Install handholes and pull boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use pull box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level 6-inch- (15-cm-) thick bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: Set so cover surface will be flush with finished grade.
- D. Install handholes and pull boxes with bottom below the frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Retain arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
  1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.

2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

### **3.07 GROUNDING**

- A. Ground underground ducts according to Division 26 Section "Grounding and Bonding for Electrical Systems."

### **3.08 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
  2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

### **3.09 CLEANING**

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

**END OF SECTION 260543**

**SECTION 260544**  
**SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
  2. Sleeve-seal systems.
  3. Sleeve-seal fittings.
  4. Grout.
  5. Silicone sealants.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**PART 2 - PRODUCTS****2.01 SLEEVES**

- A. Wall Sleeves:
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; **0.0239-inch (0.6-mm)** minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
1. Material: Galvanized sheet steel.
  2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than **50 inches (1270 mm)** and with no side larger than **16 inches (400 mm)**, thickness shall be **0.052 inch (1.3 mm)**.
    - b. For sleeve cross-section rectangle perimeter **50 inches (1270 mm)** or more and one or more sides larger than **16 inches (400 mm)**, thickness shall be **0.138 inch (3.5 mm)**.



## 2.02 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. [Advance Products & Systems, Inc.](#)
    - b. [CALPICO, Inc.](#)
    - c. [Pipeline Seal and Insulator, Inc.](#)
  2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Carbon steel.
  4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.03 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. [HOLDRITE.](#)

## 2.04 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.05 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.

- B. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch (25-mm)** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for **1-inch (25-mm)** annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### **3.02 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.03 SLEEVE-SEAL-FITTING INSTALLATION**

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

**END OF SECTION**

**SECTION 260553  
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  2. Labels.
  3. Tapes and stencils.
  4. Tags.
  5. Signs.
  6. Cable ties.
  7. Paint for identification.
  8. Fasteners for labels and signs.

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

**2.02 COLOR AND LEGEND REQUIREMENTS**

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
1. Black letters on an orange field.
  2. Legend: Indicate voltage.
- B. Color-Coding for Phase- Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
  2. Colors for 208/120-V Circuits:

- a. Phase A: Black.
  - b. Phase B: Red.
  - c. Phase C: Blue.
  3. Color for Neutral: White.
  4. Color for Equipment Grounds: Green.
- C. Warning Label Colors:
1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
- E. Equipment Identification Labels:
1. White letters on a blue phenolic nameplate.

## 2.03 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Marking Services, Inc.
    - c. Panduit Corp.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Marking Services, Inc.
    - c. Panduit Corp.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Marking Services, Inc.
    - c. Panduit Corp.
  2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Brady Corporation.
  - b. Marking Services, Inc.
  - c. Panduit Corp.
2. Minimum Nominal Size:
  - a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
  - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
  - c. As required by authorities having jurisdiction.

## 2.04 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ideal Industries, Inc.
    - b. Marking Services, Inc.
    - c. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. Marking Services, Inc.
- C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and are 12 inches (300 mm) wide. Stop stripes at legends.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. LEM Products Inc.
    - b. Marking Services, Inc.
    - c. Seton Identification Products.
- D. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Carlton Industries, LP.
    - b. Seton Identification Products.
- E. Underground-Line Warning Tape:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Marking Services, Inc.
    - c. Seton Identification Products.
  2. Tape:

- a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
  - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
- a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
  - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
  - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

## 2.05 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Marking Services, Inc.
    - c. Seton Identification Products.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch (0.38 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Marking Services, Inc.
    - c. Panduit Corp.

## 2.06 SIGNS

- A. Baked-Enamel Signs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Carlton Industries, LP.
    - b. Champion America.
    - c. Marking Services, Inc.
  2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
  3. 1/4-inch (6.4-mm) grommets in corners for mounting.
  4. Nominal Size: 7 by 10 inches (180 by 250 mm).

## 2.07 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Ideal Industries, Inc.
  2. Marking Services, Inc.
  3. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  4. Color: Black.
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
  5. Color: Black.

## 2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.02 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.

- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- J. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- K. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- L. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- M. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- N. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- P. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- Q. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.



- T. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
  - 2. Limit use of underground-line warning tape to direct-buried cables.
  - 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- U. Metal Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using general-purpose cable ties.
- V. Nonmetallic Preprinted Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using general-purpose cable ties.
- W. Baked-Enamel Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
- X. Cable Ties: General purpose, for attaching tags, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.

### **3.03 IDENTIFICATION SCHEDULE**

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- F. Conductors to Be Extended in the Future: Attach marker tape to conductors.
- G. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

- H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- I. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
  - 1. Apply to exterior of door, cover, or other access.
- L. Arc Flash Warning Labeling: Self-adhesive labels.
- M. Operating Instruction Signs: Self-adhesive labels.
- N. Equipment Identification Labels:
  - 1. Indoor Equipment: Self-adhesive melamine label.
  - 2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Field label panelboard with branch/feeder source. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Enclosed switches: Field label with branch/feeder source.
    - e. Enclosed circuit breakers.

**END OF SECTION**

**SECTION 260923  
LIGHTING CONTROL DEVICES**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. This Section includes the following lighting control devices:
  - 1. Time switches.
  - 2. Outdoor and indoor photoelectric switches.
  - 3. Indoor occupancy sensors.
  - 4. Indoor Daylighting sensors.
  - 5. Outdoor motion sensors.
  - 6. Lighting contactors.
  - 7. Emergency shunt relays.

**1.03 DEFINITIONS**

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

**1.04 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

**1.05 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

**1.06 COORDINATION**

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

**PART 2 - PRODUCTS****2.01 TIME SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Watt Stopper (The).
  2. Lutron.
  3. General Electric.
- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
1. Programs: 4 channels; each channel shall be individually programmable with 40 on-off operations per week, plus 4 seasonal schedules that modify the basic program, and an annual holiday schedule that overrides the weekly operation on holidays.
  2. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
  3. Astronomic Time: all channels.
  4. Battery Backup: For schedules and time clock.

**2.02 OUTDOOR PHOTOELECTRIC SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Area Lighting Research, Inc.; Tyco Electronics.
  2. Grasslin Controls Corporation; a GE Industrial Systems Company.
  3. Intermatic, Inc.
  4. Paragon Electric Co.; Invensys Climate Controls.
  5. Watt Stopper (The).
- B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
  2. Time Delay: 15-second minimum, to prevent false operation.
  3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
  4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

**2.03 INDOOR PHOTOELECTRIC SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allen-Bradley/Rockwell Automation.
  2. Area Lighting Research, Inc.; Tyco Electronics.
  3. Intermatic, Inc.

4. Paragon Electric Co.; Invensys Climate Controls.
  5. TORK.
  6. Watt Stopper (The).
  7. Lutron.
- B. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  3. Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lx), with an adjustment for turn-on and turn-off levels within that range.
  4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
  5. Indicator: Two LEDs to indicate the beginning of on-off cycles.
- C. Skylight Photoelectric Sensors: Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight, facing up at skylight; with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  3. Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lx), with an adjustment for turn-on and turn-off levels within that range.
  4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
  5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

## **2.04 INDOOR OCCUPANCY SENSORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. TORK.
  2. Watt Stopper (The).
  3. Lutron
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
  7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

## 2.05 OUTDOOR MOTION SENSORS (PIR)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Paragon Electric Co.; Invensys Climate Controls.
  2. TORK.
  3. Watt Stopper (The).
  4. Lutron
- B. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as raintight according to UL 773A.
1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  2. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
    - b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  3. Bypass Switch: Override the on function in case of sensor failure.
  4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc (11 to 215 lx); keep lighting off during daylight hours.
- C. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
- D. Detection Coverage: Up to 35 feet (11 m), with a field of view of 180 degrees.
- E. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.
- F. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

**2.06 LIGHTING CONTACTORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allen-Bradley/Rockwell Automation.
  2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
  3. Eaton Electrical Inc.; Cutler-Hammer Products.
  4. Schneider/Square D.
  5. GE Industrial Systems; Total Lighting Control.
- B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
  2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  3. Enclosure: Comply with NEMA 250.
  4. Provide with control and pilot devices including red "power on" pilot light, amber "On Building Automation Control" pilot light, and white "Manual Operation" pilot light. , matching the NEMA type specified for the enclosure.
- C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
1. Monitoring: On-off status and manual operation mode.
  2. Control: On-off operation, and manual operation mode. Mount selector switch to front of enclosure.

**2.07 CONDUCTORS AND CABLES**

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

**PART 3 - EXECUTION****3.01 SENSOR INSTALLATION**

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

**3.02 CONTACTOR INSTALLATION**

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

**3.03 WIRING INSTALLATION**

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).
- B. All wiring shall be installed in conduit.

- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### **3.04 IDENTIFICATION**

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### **3.05 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

### **3.06 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### **3.07 DEMONSTRATION**

- A. Coordinate demonstration of products specified in this Section with owner's staff at least 7 days in advance.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION**



SECTION 26 22 00  
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.

1.03 ACTION SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control test reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

### 1.08 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D; Schneider Electric.
  - 2. Eaton.
  - 3. General Electric.
  - 4. Siemens.

### 2.02 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Aluminum.

### 2.03 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces.
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated, NEMA 250, Type 2.
  - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Transformer Enclosure Finish: Comply with NEMA 250.
  - 1. Finish Color: Gray.
- F. Taps for Transformers Smaller Than 3 kVA: None.
- G. Taps for Transformers 7.5 to 24 kVA: Two 5 percent tap above and two 5 percent tap below normal full capacity.
- H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- J. Energy Efficiency for Transformers Rated 15 kVA and Larger:
  - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
  - 2. Tested according to NEMA TP 2.

- K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
  - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
  - 2. Indicate value of K-factor on transformer nameplate.
- L. Wall Brackets: Manufacturer's standard brackets.
- M. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

#### 2.04 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

#### 2.05 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.02 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

#### 3.03 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

#### 3.04 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

- B. Remove and replace units that do not pass tests or inspections and retest as specified above.
- C. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.05 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### 3.06 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

**SECTION 262416**  
**PANELBOARDS**

**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.
  - 3. Panelboard surge protective devices.

**1.03 DEFINITIONS**

- A. SPD: Surge protective device.
- B. SVR: Suppressed voltage rating.

**1.04 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

**1.05 SUBMITTALS**

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 7. Include wiring diagrams for power, signal, and control wiring.
  - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- C. Qualification Data: For qualified testing agency.
- D. Field Quality-Control Reports:

1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

### **1.06 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

### **1.08 PROJECT CONDITIONS**

- A. Environmental Limitations:
1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).

- b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet (2000 m).

### **1.09 COORDINATION**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

### **1.10 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 18 months from date of Substantial Completion.
  - 2. Warranty Period for Surge Protective Device: five years from date of Substantial Completion.

### **1.11 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: two spares for each type of panelboard cabinet lock.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL REQUIREMENTS FOR PANELBOARDS**

- A. Enclosures: surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, type 1.
    - b. Outdoor Locations: NEMA 250, type 4X.
    - c. Other Wet or Damp Indoor Locations: NEMA 250, type 4.
    - d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  - 2. Hinged Front Cover: Entire front trim hinged to box and with standard hinged door within hinged trim cover.
  - 3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  - 4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  - 5. Finishes:
    - a. Panels and Trim: steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.

- c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- 6. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
  
- B. Incoming Mains Location: Top and bottom.
  
- C. Phase, Neutral, and Ground Buses:
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  - 3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
  
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Main and Neutral Lugs: Mechanical type.
  - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  - 4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
  
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
  
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
  
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## **2.02 DISTRIBUTION PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company by ABB.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
  
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
  
- C. Doors: Door in door construction, secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
  
- D. Mains: Circuit breaker.
  
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes: Bolt-on circuit breakers.

## **2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company by ABB.
  - 3. Siemens Energy & Automation, Inc.



4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or as indicated on the drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Door in door construction secured with flush latch with tumbler lock; keyed alike.

#### **2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company by ABB.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits, shall be used in for sizes 225 amperes and smaller.
  2. Electronic trip circuit breakers shall be used in sizes over 400 amperes, with RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
  3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  4. Ground-Fault Equipment Protection (GFPE) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Shunt Trip: 120 trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    - f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
  1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: two normally open and normally closed contact(s) that operate with switch handle operation.

## 2.05 PANELBOARD SURGE PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Square D; a brand of Schneider Electric.
  2. Eaton.
  3. General Electric.
  4. Siemens.
- B. Surge Protective Device: IEEE C62.41-compliant, solid-state, parallel-connected, modular (with field-replaceable modules, replaceable without shutting down power to panelboard) type, with sine-wave tracking suppression and filtering modules, UL 1449 Third Edition Type 2, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
  1. Accessories:
    - a. NEMA 1 enclosure.
    - b. Fabrication using bolted compression lugs for internal wiring.
    - c. Integral disconnect switch.
    - d. Redundant suppression circuits with fused metal-oxide varistors.
    - e. Fuses rated at 200 kA interrupting capacity.
    - f. Redundant replaceable modules, one per phase minimum.
    - g. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
    - h. LED indicator lights for power and protection status.
    - i. Audible alarm, with silencing switch, to indicate when protection has failed.
    - j. Form-C contacts rated at 2 A and 24-V ac minimum, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
    - k. Six-digit, transient-event counter set to totalize transient surges.
    - l. Maximum Continuous Operating Voltage (MCOV) shall be rated for not less than 115 percent of nominal system operating voltage.
    - m. NEC/UL 1449 Short Circuit Current Rating (SCCR) complying with UL 1449 and matching or exceeding the panelboard SCCR.
    - n. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.
    - o. Repetitive Surge Current Withstand Capabilities: 12,000 IEEE C62.41 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
    - p. Protection modes and UL 1449 Voltage Protection Rating (VPR) for grounded wye circuits with 480Y/277 or 208Y/120-V as required, three-phase, four-wire circuits shall be as follows:
      - 1) Line to Neutral: 1200 V for 480Y/277, 800 V for 208Y/120.
      - 2) Line to Ground: 1200 V for 480Y/277, 800 V for 208Y/120.
      - 3) Neutral to Ground: 1200 V for 480Y/277, 800 V for 208Y/120.
      - 4) Line to Line: 2000V for 480Y/277, 1200V for 208Y/120.
    - q. UL Nominal Discharge Current Rating (In) shall be not less than 20kA.

## 2.06 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Comply with NECA 1.
- I. Install SPDs for panelboards directly adjacent to panel. Route conductors as straight and short as possible.

#### **3.03 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- E. Provide label indicating calculated available fault current and date of calculation was performed. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems." Available fault current values are annotated in the riser diagram included with the project drawings. Coordinate with designer for exact date of fault current calculation to be incorporated into the label.

### **3.04 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, and before Final Acceptance, perform an infrared scan of each new panelboard and existing transformer. Remove front panels so joints and connections are accessible to portable scanner.
- D. Tests and Inspections for SPDs:
  - 1. Ensure that interiors are free of foreign materials and dirt.
  - 2. Check and test switches, pushbuttons, and meters for proper operation.
  - 3. Check and test indicating lights for proper operation and color.
  - 4. Perform manufacturer's on-site field test procedures.
  - 5. Do not perform insulation resistance (Megger) tests of the distribution wiring equipment with the SPDs connected. Disconnect all wires, including neutral, before conducting insulation resistance tests, and reconnect immediately after the testing is over.
- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.05 ADJUSTING**

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  - 1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### **3.06 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION 262416**

**SECTION 262726  
WIRING DEVICES****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Twist-locking receptacles.
  - 3. Receptacles with integral surge suppression units.
  - 4. Wall-box motion sensors.
  - 5. Snap switches and wall-box dimmers.
  - 6. Solid-state fan speed controls.
  - 7. Wall-switch and exterior occupancy sensors.
  - 8. Communications outlets.
  - 9. Pendant cord-connector devices.
  - 10. Cord and plug sets.
  - 11. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

**1.03 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

**1.04 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

**1.05 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- C. Comply with NFPA 70.

**1.06 COORDINATION**

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

**PART 2 - PRODUCTS****2.01 MANUFACTURERS**

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

**2.02 STRAIGHT BLADE RECEPTACLES**

- A. Convenience Receptacles, 125 V, 20 A, with hex-head green grounding screw: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5351 (single), 5352 (duplex).
    - b. Hubbell; HBL5351 (single), CR5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5381 (single), 5352 (duplex).
- B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A, with hex-head green grounding screw: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; TR8300.
    - b. Hubbell; HBL8300SG.
    - c. Leviton; 8300-SGG.
    - d. Pass & Seymour; 63H.

3. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

### **2.03 GFCI RECEPTACLES**

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A, with hex-head green grounding screw: Comply with UL 498 Supplement SD.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; HGF20.
    - b. Hubbell; HGF8300.
    - c. Leviton; 6898-HG.

### **2.04 TWIST-LOCKING RECEPTACLES**

- A. Single Convenience Receptacles, 125 V, 20 A, with hex-head green grounding screw: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; L520R.
    - b. Hubbell; HBL2310.
    - c. Leviton; 2310.
    - d. Pass & Seymour; L520-R.

### **2.05 PENDANT CORD-CONNECTOR DEVICES**

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
  1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
  2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

### **2.06 CORD AND PLUG SETS**

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
  2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

### **2.07 SNAP SWITCHES**

- A. Comply with NEMA WD 1 and UL 20.



**B. Switches, 120/277 V, 20 A:**

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
  - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
  - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
  - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

**C. Pilot Light Switches, 20 A:**

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; 2221PL for 120 V and 277 V.
  - b. Hubbell; HPL1221PL for 120 V and 277 V.
  - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
  - d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

**D. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.**

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; 1995.
  - b. Hubbell; HBL1557.
  - c. Leviton; 1257.
  - d. Pass & Seymour; 1251.

**E. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.**

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; 1995L.
  - b. Hubbell; HBL1557L.
  - c. Leviton; 1257L.
  - d. Pass & Seymour; 1251L.

**2.08 WALL-BOX DIMMERS**

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

**2.09 FAN SPEED CONTROLS**

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.

1. Continuously adjustable slider.

## 2.10 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  2. Plate-Securing Screws: Stainless steel to match plate finish.
  3. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel.
  4. Material for Unfinished Spaces: Galvanized steel.
  5. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

## 2.11 FLOOR SERVICE FITTINGS

- C. Type: Cast iron, adjustable, flush in floor type with lifting cover. Lifting lids shall have cable openings to allow for lid to be closed when outlet is in use.
- D. Service Plate: with carpet flange or tile trim for floor material.
- E. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, refer to drawings for quantities.
- F. Voice and Data Communication Outlets: refer to drawings for quantities.

## 2.12 MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Hubbell Incorporated; Wiring Device-Kellems.
  2. Wiremold Company (The).
- G. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- H. Raceway Material: Metal, with color as selected by architect from manufacturer's standard finishes.
- I. Wire: No. 12 AWG.

## 2.13 SERVICE POLES

- J. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
  1. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
  2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
  3. Finishes: Satin-anodized aluminum.
  4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 6 voice and data communication cables.
  5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units unless otherwise indicated.
  6. Voice and Data Communication Outlets: as indicated on the drawings.

**2.14 FINISHES**

- K. Color: Wiring device catalog numbers in Section Text do not designate device color.
  - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
  - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
  - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
  - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  - 8. Tighten unused terminal screws on the device.
  - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
  2. Verify that dimmers used for fan speed control are listed for that application.
  3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### **3.02 IDENTIFICATION**

- A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### **3.03 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
  2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
  3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

**END OF SECTION**

**SECTION 262813  
FUSES****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
1. Cartridge fuses rated 600 V ac and less for use in the following:
    - a. Control circuits.
    - b. Enclosed switches.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  2. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
  3. Coordination charts and tables and related data.

**1.04 FIELD CONDITIONS**

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

**PART 2 - PRODUCTS****2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Busmann, an Eaton business.
  2. Edison; a brand of Busmann by Eaton.
  3. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

**2.02 CARTRIDGE FUSES**

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
1. Type RK-1: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
  2. Type RK-5: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
  3. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 FUSE APPLICATIONS**

- A. Cartridge Fuses:
  - 1. Service Entrance: Class RK1, time delay or Class J, time delay.
  - 2. Feeders: Class RK1, time delay or Class J, time delay.
  - 3. Motor Branch Circuits: Class RK5, time delay.
  - 4. Power Electronics Circuits: Class J, high speed.
  - 5. Other Branch Circuits: Class RK5, time delay.
  - 6. Control Transformer Circuits: Class CC, time delay, control transformer duty.
  - 7. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

#### **3.03 INSTALLATION**

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

#### **3.04 IDENTIFICATION**

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

**END OF SECTION**

SECTION 26 28 16  
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Shunt trip switches.
  - 4. Enclosures.

1.03 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of NRTL listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. Include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

#### 1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

#### 1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  1. Notify Owner no fewer than ten working days in advance of proposed interruption of electric service.
  2. Indicate method of providing temporary electric service.
  3. Do not proceed with interruption of electric service without Owner's written permission.
  4. Comply with NFPA 70E.

#### 1.09 COORDINATION

- A. Coordinate layout and installation of switches and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

### PART 2 - PRODUCTS

#### 2.01 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Square D; a brand of Schneider Electric.
  2. General Electric.
  3. Eaton/Cutler-Hammer.
  4. Siemens.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.



3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 2.02 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Square D; a brand of Schneider Electric.
  2. General Electric.
  3. Eaton/Cutler-Hammer.
  4. Siemens.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
  4. Hookstick Handle: Allows use of a hookstick to operate the handle.
  5. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 2.03 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cooper Bussmann, Inc.
  2. Mersen - Ferraz Shawmut, Inc.
  3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
  1. Oiltight key switch for key-to-test function.
  2. Oiltight green ON pilot light.
  3. Isolated neutral lug; 100 percent rating.

4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety interface relay; 120-V ac coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

## 2.04 ENCLOSURES

- A. NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed locations.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  2. Outdoor Locations: NEMA 250, Type 3R.
  3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- d. Comply with NECA 1.

### 3.03 IDENTIFICATION

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16

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**SECTION 265119****LED INTERIOR LIGHTING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Refer to luminaire schedule on the drawings for luminaire designations. These shall include but are not limited to:
1. Cylinder.
  2. Downlight.
  3. Highbay, nonlinear.
  4. Recessed, linear.
  5. Strip light.
  6. Surface mount, linear.
  7. Surface mount, nonlinear.
  8. Suspended, linear.
  9. Suspended, nonlinear.
  10. Exit signs

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
1. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
  2. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
  2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
- C. Product Certificates: For each type of luminaire.
- D. Product test reports.
- E. Sample warranty.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

**1.05 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a two-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Fidelity Index and Gamut Index shall be at least 90 and 100 respectively or as indicated on Luminaire Schedule. Submit compliance data with shop drawings.
- F. Comply with IEEE standard for flicker, 1789-2015. Submit compliance data with shop drawings.

**1.06 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Ambient Temperature: 5 to 104 deg F
  - 1. Relative Humidity: Zero to 95 percent.
- C. Altitude: Sea level to 3000 ft.
- D. LED drivers shall be modular, replaceable type, with plug in construction type.

**2.02 LUMINAIRE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended LED chip assemblies and drivers. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when LED light engines are in place.
  - 1. Label shall include the following characteristics:

- a. "USE ONLY" and include specific LED type and LED driver type.
  - b. LED chip assembly replacement part number.
  - c. Fidelity and Gamut index.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- G. Diffusers and Globes: 100% virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation. Lens thickness shall be at least 0.125" minimum. Lens shall be UV stabilized.
- H. Glass: Annealed crystal glass unless otherwise indicated.
- I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Provide safety cables for gym and other high bay type luminaires.
- J. See Editing Instruction No. 8 in the Evaluations for discussion on luminaire labeling.

### **2.03 METAL FINISHES**

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

### **2.04 LUMINAIRE SUPPORT**

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Factory install LED chip assemblies and drivers in each luminaire.
- D. Wireguards: Provide wireguards for all gym and auxiliary gym luminaires.
- E. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Supports in gym and auxiliary gym shall be swivel/knuckle type to allow movement of luminaire without breaking.
  - 3. Able to maintain luminaire position after cleaning and relamping.
  - 4. Provide support for luminaire without causing deflection of ceiling or wall.
  - 5. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

**3.02 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

**3.03 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

**END OF SECTION**