Student Union Student Activities Area
Friedman Student Union Building

Contract Documents and Specifications

For
NORTHWESTERN STATE
UNIVERSITY of LOUISIANA

Sutton Beebe Babin Architects, LLC
333 Texas Street
Suite 1200
Shreveport, LA 71101
rjames@sbbarchitects.com

NSU Project # SB#7594

Date: June 5, 2019
Contract Documents and Specifications
for
Student Union Student Activities Area
for
Northwestern State University of Louisiana
Natchitoches, Louisiana 71497

Table of Contents

DIVISION I – Bidding Forms
Document 000107 Seals Page .................................................................000107-1
Invitation for Bid.................................................................BF-1
Notice to Bidders..............................................................BF-2 Thru 6
Insurance Requirements................................................BF-7 Thru 10
Indemnification Agreement........................................BF-11 Thru 16
Attestations.............................................................BF-17
On-Site Visit/Inspection Form........................................BF-18
Louisiana Uniform Public Work Bid Form........................BF-19
Bid Bond................................................................BF-20
Notification Letter........................................................BF-21
Contract Between Owner and Contractor and Performance and Payment Bond......C-1-3 Thru C-5-3

DIVISION II – General Requirements
Section 011000 Summary .........................................................011000-1
Section 012000 Price and Payment Procedures........................................012000-1
Section 012600 Contract Modification Procedures .................................012600-1
Section 013000 Administrative Requirements.........................................013000-1 Thru 3
Section 014000 Quality Requirements........................................014000-1 Thru 2
Section 015000 Temporary Facilities and Controls..................................015000-1 Thru 2
Section 016000 Product Requirements ................................................016000-1 Thru 2
Section 017000 Execution and Closeout Requirements..........................017000-1 Thru 5
Section 017419 Construction Waste Management and Disposal ........017419-1
DIVISION III – Special Provisions
(Not Used)

DIVISION IV – Technical Specifications
Section 024119 Selective Demolition..............................................................024119-1 Thru 2
Section 033000 Cast-In-Place Concrete..........................................................033000-1 Thru 2
Section 035413 Gypsum Cement Underlayment..............................................035413-1 Thru 1
Section 061053 Miscellaneous Rough Carpentry..............................................061053-1 Thru 2
Section 061600 Sheathing..................................................................................061600-1 Thru 2
Section 079200 Joint Sealants............................................................................079200-1 Thru 2
Section 081113 Hollow Metal Frames...............................................................081113-1 Thru 2
Section 081416 Flush Wood Doors....................................................................081416-1 Thru 2
Section 084113 Aluminum-Framed Entrances and Storefronts..........................084113-1 Thru 2
Section 087100 Door Hardware.........................................................................087100-1 Thru 2
Section 088000 Glazing......................................................................................088000-1 Thru 2
Section 092216 Non-Structural Metal Framing.................................................092216-1 Thru 1
Section 092900 Gypsum Board..........................................................................092900-1 Thru 2
Section 095113 Acoustical Panel Ceilings.........................................................095113-1 Thru 2
Section 096513 Resilient Base and Accessories.................................................096513-1 Thru 2
Section 096519 Resilient Tile Flooring..............................................................096519-1 Thru 1
Section 099123 Interior Painting........................................................................099123-1 Thru 2
Section 099300 Staining and Transparent Finishing...........................................099300-1 Thru 2
Section 101400 Signage.....................................................................................101400-1 Thru 2
Section 104400 Fire Protection Specialties......................................................104400-1 Thru 3
Section 123623.13 Plastic-Laminate-Clad Countertops.....................................123623.13-1 Thru 2
Section 123661.16 Solid Surface Countertops..................................................123661.16-1 Thru 2
Section 210000 Fire Protection...........................................................................210000-1 Thru 10
Section 220500 Hangers and Supports for Plumbing and HVAC.....................220500-1 Thru 5
Section 230100 Basic Mechanical Materials and Methods..............................230100-1 Thru 12
Section 230130 HVAC Air Distribution System Cleaning................................230130-1 Thru 3
Section 230200 Motors for HVAC....................................................................230200-1 Thru 4
Section 230553 Mechanical Identification for HVAC Piping and Equipment......230553-1 Thru 4
Section 230593 Testing, Adjusting, and Balancing............................................230593-1 Thru 3
Section 230713 Duct Insulation.........................................................................230713-1 Thru 14
Section 230719 Pipe Insulation for HVAC.......................................................230719-1 Thru 8
Section 230923 Building Management and Control System .................................................. 230923-1 Thru 9
Section 231716 Condensate Drain Piping ................................................................. 231716-1 Thru 2
Section 232300 Refrigerant Piping ............................................................... 232300-1 Thru 9
Section 233000 Ductwork Accessories ................................................................. 233330-1 Thru 6
Section 233113 Metal Ducts .............................................................................. 233113-1 Thru 8
Section 233713 Diffusers, Registers, and Grilles .................................................. 233713-1 Thru 2
Section 238100 Variable Refrigerant Volume (VRV) HVAC System Controller .... 238100-1 Thru 6
Section 238125 Variable Refrigerant Volume HVAC Split System (Heat Pump) ...... 238125-1 Thru 13
Section 238130 Multi Evaporator DX Split System Indoor Units ....................... 238130-1 Thru 21
Section 260500 Basic Electrical Materials and Methods ..................................... 260500-1 Thru 11
Section 260519 Conductors and Cables ................................................................. 260519-1 Thru 3
Section 260526 Grounding and Bonding ............................................................... 260526-1 Thru 4
Section 260533 Raceways and Boxes ................................................................. 260533-1 Thru 7
Section 260923 Lighting Control Devices ............................................................. 260923-1 Thru 4
Section 262416 PanelBoards ............................................................................ 262416-1 Thru 7
Section 262726 Wiring Devices ........................................................................... 262726-1 Thru 5
Section 262813 Fuses ......................................................................................... 262813-1 Thru 3
Section 262816 Enclosed Switches ...................................................................... 262816-1 Thru 4
Section 264313 Surge Protective Devices ............................................................. 264313-1 Thru 3
Section 265100 Interior Lighting .......................................................................... 265100-1 Thru 9
Section 271100 Communication Equipment Room Fittings .................................. 271100-1 Thru 5
Section 271500 Communications Horizontal Cabling ............................................. 271500-1 Thru 9

DIVISION V – Drawings
Cover Sheet ............................................................................................................
Demolition Plans .................................................................................................... AD1.01
Renovation Plans .................................................................................................. A1.01
Reflected Ceiling Plans ....................................................................................... A1.10
Interior Elevations ............................................................................................... A2.01
Interior Elevations ............................................................................................... A2.02
Interior Elevations ............................................................................................... A2.03
Details and Schedules ......................................................................................... A3.01
Details ..................................................................................................................... A3.02
Demolition Plan – HVAC ..................................................................................... MD1.01
Mechanical Schedules ......................................................................................... M0.01
Mechanical Schedules and Details

Renovation Plan – HVAC

Demolition Plan – Electrical

Renovation Plans - Lighting

Renovation Plans – Power and Signal

2nd Floor Plan - Power

Electrical Schedules

Electrical Details
DIVISION I

BIDDING FORMS
1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:
   1. Sutton Beebe Babin Architects, LLC.
   3. LA 2968.
   4. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.

B. Mechanical Engineer:
   3. LA Professional Engineer License No. 27979.
   4. Responsible for Division 21 & 23.

C. Electrical Engineer:
   2. Pat Foreman.
   3. LA Professional Engineer License No. 22378.
   4. Responsible for Division 26 & 27.
INVITATION FOR BID: Sealed bid, subject to the conditions herein stated and attached hereto, will be received at this office until August 15, 2019 at 2:00 PM and then publicly opened for furnishing the items and/or services as described below for Northwestern State University.

A MANDATORY PRE-BID MEETING: will be held at the NSU Physical Plant Office, 998 South Jefferson, Natchitoches, LA 71497 on August 8, 2019 at 10:00 AM.

DESCRIPTION

NSU Student Union Student Activities Area – 185 Sam Sibley Dr., Natchitoches, LA 71497

PLEASE FILL IN ALL BLANK SPACES

Terms will be N/A and shipment will be received within N/A days after receipt of order.

In compliance with and subject to the conditions thereof, the undersigned offers and agrees if this bid be accepted within 30 days from date of opening to furnish any or all of the items (or sections) at the price set opposite each item (or section).

<table>
<thead>
<tr>
<th>VENDOR NAME</th>
<th>SIGNATURE AUTHORITY</th>
<th>(Re: L.R.S. 39:1594(Act 121)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>TITLE</td>
<td></td>
</tr>
<tr>
<td>CITY, STATE, ZIP</td>
<td>TAX IDENTIFICATION NUMBER</td>
<td></td>
</tr>
<tr>
<td>TELEPHONE NUMBER</td>
<td>FAX NUMBER</td>
<td></td>
</tr>
<tr>
<td>DATE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ACCEPTANCE/AWARD

DATE OF AWARD AND EXECUTION

Recommendation:                         

Approved:  
  Director of Purchasing  
  Dale Martin
NOTICE TO BIDDERS

Bid security must be attached (insurance company, bank money order, certified check or cashier's check) in the sum of five percent (5%) of the amount bid (including base bid and additive alternates, if any) and shall become the property of the owner in the event the contract and bond are not executed within the time set forth above. If bid bond is used, it shall be written by a surety or insurance company currently on the U.S. Department of the Treasury Financial Management service list of approved bonding companies which is published annually in the Federal Register, or by a Louisiana domiciled insurance company with at least an A-rating in the latest printing of the A.M. Best's Key Rating Guide to write individual bonds up to ten percent of policyholders' surplus as shown in the A.M. Best's Key Rating Guide, or by an insurance company that is either domiciled in Louisiana or owned by Louisiana residents and is licensed to write surety bonds. In addition, the bond shall be written by a surety or insurance company that is currently licensed to do business in the State of Louisiana.

Bids shall be accepted only from Contractors who are licensed under La. R.S. 37:2150-2163 for the classification(s) such as Building Construction work. No bid may be withdrawn for a period of thirty (30) days after receipt of bids. IN ACCORDANCE LA R.S. 37:2163 “ANYONE OBJECTING TO THE CLASSIFICATION MUST SEND A CERTIFIED LETTER TO BOTH THE LOUISIANA STATE LICENSING BOARD FOR CONTRACTORS AND THE OFFICE OF STATE PURCHASING. THE LETTER MUST BE RECEIVED NO LATER THAN TEN WORKING DAYS PRIOR TO THE DAY ON WHICH BIDS ARE TO BE OPENED.

When this project is financed either partially or entirely with State Bonds, the award of this Contract is contingent upon the sale of bonds by the State Bond Commission. The State shall incur no obligation to the Contractor until the Contract between Owner and Contractor is fully executed.

BIDDING PROCEDURE

All bids must be submitted on the forms provided for this purpose and must be filled out with ink or typewritten and signed in ink. Any interlineations, alteration or erasure must be initialed by the signer of the bid.

Bidder shall assume full responsibility for timely delivery to the location designated for receipt of bids. Any bids received after the designated opening time will be returned unopened.

The Division of Administration of the State of Louisiana is an equal opportunity employer and looks to its Contractors, Subcontractors, vendors and suppliers to take affirmative action to affect this commitment in its operations.

Compliance with civil rights laws. By submitting and signing this solicitation, the bidder agrees to abide by the requirements of the following as applicable: Title VI and Title VII of the Civil Rights Act of 1964, as amended by the Equal Opportunity Act of 1972, Federal Executive Order 11246, the Federal Rehabilitation Act of 1973, as amended, the Vietnam Era Veteran's Readjustment Assistance Act of 1974, Title IX of the Education Amendments of 1972, the Age Act of 1975, and bidder agrees to abide by the requirements of the Americans With Disabilities Act of 1990. Bidder agrees not to discriminate in its employment practices, and will render services under any contract entered into as a result of this solicitation, without regard to race, color, religion, sex, national origin, veteran status, political affiliation, or disabilities. Any act of discrimination committed by bidder, or failure to comply with these statutory obligations when applicable, shall be grounds for termination of any contract entered into as a result of this solicitation.
In accordance with the provisions of R.S. 39:2192, in awarding contracts after August 15, 2010, any public entity is authorized to reject a proposal or bid from, or not award the contract to, a business in which any individual with an ownership interest of five percent or more, has been convicted of, or has entered a plea of guilty or nolo contendere to any state felony or equivalent federal felony crime committed in the solicitation or execution of a contract or bid awarded under laws governing public contracts under the provisions of Chapter 10 or Title 38 of the Louisiana Revised Statutes of 1950, Professional, Personal, Consulting, and Social Services Procurement under the provisions of Chapter 16 of this Title, or the Louisiana Procurement Code under the provisions of Chapter 17 of this Title.

Any product or service bid shall conform to all applicable Federal and State Laws and Regulations and the specifications contained in the solicitation. Unless otherwise specified in the solicitation, any manufacturer’s name, trade name, brand name, or catalog number used in the specification is for the purpose of describing the standard of quality, performance, and characteristic desired and is not intended to limit or restrict competition.

**BIDDERS REPRESENTATION:**

In making his bid, each bidder represents that: He has read and understands the bid documents and his bid is made in accordance herewith; he has visited the site and has familiarized himself with the local conditions under which the work is to be performed; and his bid is based upon the specifications described in the bid documents without exception.

**ADDENDA:**

No Addenda will be issued within a period of seventy-two (72) hours prior to the date set for receipt of bids, except an Addendum, if necessary, postponing the date of receipt of bids or canceling the request for bids.

Receipt of all Addenda issued should be acknowledged in bid proposal and/or returned with bid proposal. Addenda must be acknowledged upon request.

It is the Bidder’s responsibility to check website link: https://wwwcfprd.doa.louisiana.gov/OSP/LaPAC/pubmain.cfm frequently for any possible addenda that may be issued. Northwestern State University of Louisiana is not responsible for a Bidder’s failure to download any addenda documents required to complete an Invitation to Bid.

**BIDDER INQUIRIES:**

The State shall not and cannot permit an open-ended inquiry period, as this creates an unwarranted delay in the procurement cycle and operations of our agency customers. The State reasonably expects and requires responsible and interested bidders to conduct their in-depth bid review and submit inquiries in a timely manner.

An inquiry period is hereby firmly set for all interested bidders to perform a detailed review of the bid documents and to submit any written inquiries relative thereto. Without exception, all inquiries MUST be submitted in writing by an authorized representative of the proposer, clearly cross-referenced to the relevant bid section. All inquiries must be received by the close of business ten calendar days prior to the original bid opening date. Only those inquiries received by the established deadline shall be considered by the State. Inquiries received after the established deadline shall not be entertained.

Inquiries concerning this bid may be delivered by mail, express courier, e-mail, hand, or fax to:
An addendum will be issued and posted at the Office of State Purchasing LaPAC* website, to address all inquiries received and any other changes or clarifications to the bid. Thereafter, all bid documents, including but not limited to the specifications, terms, conditions, plans, etc., will stand as written and/or amended by any addendum. No negotiations, decisions, or actions shall be executed by any bidder as a result of any oral discussions with any state employee or state consultant. It is the Proposer’s responsibility to check the LaPAC website frequently for any possible addenda that may be issued. The Office of State Purchasing is not responsible for a bidder’s failure to download any addenda documents required to complete the bid.

*Note: LaPAC is the state’s online electronic bid posting and notification system resident on State Purchasing’s website [www.doa.louisiana.gov/osp] and is available for vendor self-enrollment. In that LaPAC provides an immediate e-mail notification to subscribing bidders that a solicitation and any subsequent addenda have been let and posted, notice and receipt thereof is considered formally given as of their respective dates of posting.

**COMPLIANCE REGARDING SUSPENSION/DEBARMENT:**

CERTIFICATION OF NO SUSPENSION OR DEBARMENT. BY SIGNING AND SUBMITTING ANY BID FOR $25,000 OR MORE, THE BIDDER CERTIFIES THAT THEIR COMPANY, ANY SUBCONTRACTORS, OR PRINCIPALS ARE NOT SUSPENDED OR DEBARRED BY THE GENERAL SERVICES ADMINISTRATION (GSA) IN ACCORDANCE WITH THE REQUIREMENTS IN OMB CIRCULAR A-133.

A LIST OF PARTIES WHO HAVE BEEN SUSPENDED OR DEBARRED CAN BE VIEWED VIA THE INTERNET AT WWW.EPLS.GOV.

**CONSIDERATION OF BIDS:**

Northwestern State University of Louisiana reserves the right to reject any or all bids and in particular to reject a bid not accompanied by any required bid security or data required by the bid documents or a bid in anyway incomplete or irregular.

Northwestern State University of Louisiana reserves the right to waive any informality or irregularity in any bid received, deemed to be in the best interest of the State of Louisiana.

**RECORDATION CERTIFICATE:**

 Contractor upon receipt of executed contract, bond, purchase order and Notice to Proceed shall record contract and bond with the Clerk of Court in the parish in which the work is to be performed, obtain a Certificate of Recordation from the Clerk of Court and forward this Certificate immediately to Northwestern State University of Louisiana. The contracting agency will process no invoices until receipt of the Certificate of Recordation.
CONTRACT, PERFORMANCE BOND, LABOR AND MATERIALS PAYMENT BOND:

If the undersigned is notified of the acceptance of the above bid or bids, within thirty (30) days of the time set forth for the opening of bids, he agrees to execute a contract for the work accepted, in the standard contract form currently used by Northwestern State University of Louisiana within ten (10) days after notice from NSU.

The undersigned further agrees, if awarded the contract, to execute and deliver to NSU at the time the contract documents are executed, a Performance Bond with Power of Attorney, on the forms provided, in an amount equal to the contract sum and agrees that this bond will be secured by a surety or insurance company currently on the U.S. Department of the Treasury Financial Management Service list of approved bonding companies which is published annually in the Federal Register, or by a Louisiana domiciled insurance company with at least an A- rating in the latest printing of the A.M. Best's Key Rating Guide to write individual bonds up to ten percent of policyholders' surplus as shown in the A.M. Best's Key Rating Guide, or by an insurance company that is either domiciled in Louisiana or owned by Louisiana residents and is licensed to write surety bonds. In addition, the bond shall be written by a surety or insurance company that is currently licensed to do business in the state of Louisiana. Also, to be provided at the same time is a Labor and Materials Payment Bond in an amount equal to 100% of the contract amount.

Termination of the Contract for Convenience

Northwestern State University of Louisiana may terminate the contract at any time by giving thirty (30) days written notice to the Contractor of such termination or negotiating with the Contractor an effective date.

The Contractor shall be entitled to payment for deliverables in progress, to the extent work has been performed satisfactorily.

BID SECURITY:

Bid security must be attached (insurance company, bank money order, certified check or cashier's check) in the sum of five percent (5%) of the amount bid (including base bid and additive alternates, if any) and shall become the property of the owner in the event the contract and bond are not executed within the time set forth above. If bid bond is used, it shall be written by a surety or insurance company currently on the U.S. Department of the Treasury Financial Management service list of approved bonding companies which is published annually in the Federal Register, or by a Louisiana domiciled insurance company with at least an A- rating in the latest printing of the A.M. Best's Key Rating Guide to write individual bonds up to ten percent of policyholders' surplus as shown in the A.M. Best's Key Rating Guide, or by an insurance company that is either domiciled in Louisiana or owned by Louisiana residents and is licensed to write surety bonds. In addition, the bond shall be written by a surety or insurance company that is currently licensed to do business in the state of Louisiana.

AFFIDAVIT:

Successful Contractor shall be required to execute an affidavit attesting "THAT PUBLIC CONTRACT WAS NOT SECURED THROUGH EMPLOYMENT OR PAYMENT OF SOLICITOR".

REJECTION OF BIDS:

The undersigned understands that Northwestern State University of Louisiana reserves the right to reject any and all bids and to waive any informalities.
WITHDRAWAL OF BIDS:

The undersigned agrees that this bid shall be good and may not be withdrawn for a period of thirty (30) calendar days after the bid opening.

PROGRESS PAYMENTS: The following payment schedule shall apply:

For contracts with a completion date of more than thirty (30) days:

On or about the first day of each month, ninety percent (90%) of the value based on the Contract Price of labor and materials incorporated in the work and of materials suitably stored at the site thereof up to the first day of that month, as estimated by the owner, less the aggregate of previous payments and upon substantial completion of the entire work, a sum sufficient to increase the total payment to ninety percent (90%) of the Contract Price.

For contracts with a completion date of thirty (30) days or less:

Upon satisfactory completion of the work, ninety percent (90%) of the Contract Price.

ACCEPTANCE:

Upon written notice by Northwestern State University of Louisiana, a Notice by Owner of Acceptance of Work will be executed and forwarded to the Contractor for recording with the Clerk of Court in the parish in which the work has been performed and shall furnish a clear Lien Certificate from the Clerk of Court (to the owner along with final invoice) forty-five (45) days after recordation of acceptance. Final payment of ten percent (10%) will be made at this time.

Any punch list generated during or after construction shall include the cost estimates for the particular items of work a design professional has developed based on the mobilization, labor, material, and equipment costs of correcting each punch list item. The design professional shall retain his working papers used to determine the punch list items cost estimates should the matter be disputed later. Owner shall not withhold from payment more than the value of the punch list. Punch list items completed shall be paid upon the expiration of the forty-five (45) days lien period.

INSURANCE:

Compensation Insurance, public liability and property damage insurance, as per the attached insurance requirements, are required on this bid.
INSURANCE REQUIREMENTS

CONTRACTOR'S LIABILITY INSURANCE

Proof of Insurance will be required before work can commence.

Insurance coverage specified below shall be furnished with the following minimum limits:

COMPENSATION INSURANCE: THE CONTRACTOR AND SUBCONTRACTORS SHALL PURCHASE AND MAINTAIN DURING THE DURATION OF THE CONTRACT INSURANCE AGAINST CLAIMS FOR INJURIES TO PERSONS OR DAMAGES TO PROPERTY WHICH MAY ARISE FROM OR IN CONNECTION WITH THE PERFORMANCE OF THE WORK HEREUNDER BY THE CONTRACTOR, ITS AGENTS, REPRESENTATIVES, EMPLOYEES OR SUBCONTRACTORS.

A. MINIMUM SCOPE AND LIMITS OF INSURANCE

WORKERS COMPENSATION

WORKERS COMPENSATION INSURANCE SHALL BE IN COMPLIANCE WITH THE WORKERS COMPENSATION LAW OF THE STATE OF THE CONTRACTOR'S HEADQUARTERS. EMPLOYERS LIABILITY IS INCLUDED WITH A MINIMUM LIMIT OF $500,000 PER ACCIDENT/PER DISEASE/PER EMPLOYEE. IF WORK IS TO BE PERFORMED OVER WATER AND INVOLVES MARITIME EXPOSURE, APPLICABLE LHWCA, JONES ACT, OR OTHER MARITIME LAW COVERAGE SHALL BE INCLUDED AND THE EMPLOYERS LIABILITY LIMIT INCREASED TO A MINIMUM OF $1,000,000. A.M. BEST'S INSURANCE COMPANY RATING REQUIREMENT MAY BE WAIVED FOR WORKERS COMPENSATION COVERAGE ONLY.

COMMERCIAL GENERAL LIABILITY

COMMERCIAL GENERAL LIABILITY INSURANCE, INCLUDING PERSONAL AND ADVERTISING INJURY LIABILITY, SHALL HAVE A MINIMUM LIMIT PER OCCURRENCE OF $1,000,000 AND A MINIMUM GENERAL AGGREGATE OF $2,000,000. THE INSURANCE SERVICES OFFICE (ISO) COMMERCIAL GENERAL LIABILITY OCCURRENCE COVERAGE FORM CG 00 01 (CURRENT FORM APPROVED FOR USE IN LOUISIANA), OR EQUIVALENT, IS TO BE USED IN THE POLICY. CLAIMS-MADE FORM IS UNACCEPTABLE.

AUTOMOBILE LIABILITY

AUTOMOBILE LIABILITY INSURANCE SHALL HAVE A MINIMUM COMBINED SINGLE LIMIT PER OCCURRENCE OF $1,000,000. ISO FORM NUMBER CA 00 01 (CURRENT FORM APPROVED FOR USE IN LOUISIANA), OR EQUIVALENT, IS TO BE USED IN THE POLICY. THIS INSURANCE SHALL INCLUDE THIRD-PARTY BODILY INJURY AND PROPERTY DAMAGE LIABILITY FOR OWNED, HIRED AND NON-OWNED AUTOMOBILES.

DEDUCTIBLES AND SELF-INSURED RETENTIONS

ANY DEDUCTIBLES OR SELF-INSURED RETENTIONS MUST BE DECLARED TO AND ACCEPTED BY THE AGENCY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DEDUCTIBLES AND SELF-INSURED RETENTIONS.
OTHER INSURANCE PROVISIONS
THE POLICIES ARE TO CONTAIN, OR BE ENDORSED TO CONTAIN, THE FOLLOWING PROVISIONS:

GENERAL LIABILITY AND AUTOMOBILE LIABILITY COVERAGES

THE AGENCY, ITS OFFICERS, AGENTS, EMPLOYEES AND VOLUNTEERS SHALL BE NAMED AS AN ADDITIONAL INSURED AS REGARDS NEGLIGENCE BY THE CONTRACTOR. ISO FORM CG 20 10 (CURRENT FORM APPROVED FOR USE IN LOUISIANA), OR EQUIVALENT, IS TO BE USED WHEN APPLICABLE. THE COVERAGE SHALL CONTAIN NO SPECIAL LIMITATIONS ON THE SCOPE OF PROTECTION AFFORDED TO THE AGENCY.

THE CONTRACTOR'S INSURANCE SHALL BE PRIMARY AS RESPECTS THE AGENCY, ITS OFFICERS, AGENTS, EMPLOYEES AND VOLUNTEERS. ANY INSURANCE OR SELF-INSURANCE MAINTAINED BY THE AGENCY SHALL BE EXCESS AND NON-CONTRIBUTORY OF THE CONTRACTOR'S INSURANCE.

ANY FAILURE OF THE CONTRACTOR TO COMPLY WITH REPORTING PROVISIONS OF THE POLICY SHALL NOT AFFECT COVERAGE PROVIDED TO THE AGENCY, ITS OFFICERS, AGENTS, EMPLOYEES AND VOLUNTEERS.

THE CONTRACTOR'S INSURANCE SHALL APPLY SEPARATELY TO EACH INSURED AGAINST WHO CLAIM IS MADE OR SUIT IS BROUGHT, EXCEPT WITH RESPECT TO THE POLICY LIMITS.

WORKERS COMPENSATION AND EMPLOYERS LIABILITY COVERAGE THE INSURER SHALL AGREE TO WAIVE ALL RIGHTS OF SUBROGATION AGAINST THE AGENCY, ITS OFFICERS, AGENTS, EMPLOYEES AND VOLUNTEERS FOR LOSSES ARISING FROM WORK PERFORMED BY THE CONTRACTOR FOR THE AGENCY. ALL COVERAGES

COVERAGE SHALL NOT BE CANCELED, SUSPENDED, OR VOIED BY EITHER PARTY (THE CONTRACTOR OR THE INSURER) OR REDUCED IN COVERAGE OR IN LIMITS EXCEPT AFTER 30 DAYS WRITTEN NOTICE HAS BEEN GIVEN TO THE AGENCY. TEN-DAY WRITTEN NOTICE OF CANCELLATION IS ACCEPTABLE FOR NON-PAYMENT OF PREMIUM. NOTIFICATIONS SHALL COMPLY WITH THE STANDARD CANCELLATION PROVISIONS IN THE CONTRACTOR'S POLICY.

NEITHER THE ACCEPTANCE OF THE COMPLETED WORK NOR THE PAYMENT THEREOF SHALL RELEASE THE CONTRACTOR FROM THE OBLIGATIONS OF THE INSURANCE REQUIREMENTS OR INDEMNIFICATION AGREEMENT.

THE INSURANCE COMPANIES ISSUING THE POLICIES SHALL HAVE NO RECOURSE AGAINST THE AGENCY FOR PAYMENT OF PREMIUMS OR FOR ASSESSMENTS UNDER ANY FORM OF THE POLICIES.

ANY FAILURE OF THE CONTRACTOR TO COMPLY WITH REPORTING PROVISIONS OF THE POLICY SHALL NOT AFFECT COVERAGE PROVIDED TO THE AGENCY, ITS OFFICERS, AGENTS, EMPLOYEES AND VOLUNTEERS.
ACCEPTABILITY OF INSURERS

All required insurance shall be provided by a company or companies lawfully authorized to do business in the jurisdiction in which the project is located. Insurance shall be placed with insurers with a A.M. Best's rating of A-:VI or higher. This rating requirement may be waived for workers compensation coverage only.

If at any time an insurer issuing any such policy does not meet the minimum A.M. Best rating, the contractor shall obtain a policy with an insurer that meets the A.M. Best rating and shall submit another certificate of insurance as required in the contract.

VERIFICATION OF COVERAGE

Contractor shall furnish the agency with certificates of insurance reflecting proof of required coverage. The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. The certificates are to be received and approved by the agency before work commences and upon any contract renewal thereafter.

In addition to the certificates, contractor shall submit the declarations page and the cancellation provision endorsement for each insurance policy. The agency reserves the right to request complete certified copies of all required insurance policies at any time.

Upon failure of the contractor to furnish, deliver and maintain such insurance as above provided, this contract, at the election of the agency, may be suspended, discontinued or terminated. Failure of the contractor to purchase and/or maintain any required insurance shall not relieve the contractor from any liability or indemnification under the contract.

SUBCONTRACTORS

Contract shall include all subcontractors as insureds under its policies or shall be responsible for verifying and maintaining the certificates provided by each subcontractor. Subcontractors shall be subject to all of the requirements stated herein. The agency reserves the right to request copies of subcontractor's certificates at any time.

Workers compensation indemnity in the event contractor is not required to provide or elects not to provide workers compensation coverage, the parties hereby agree that contractor, its owners, agents and employees will have no cause of action against, and will not assert a claim against, the state of Louisiana, its departments, agencies, agents and employees as an employer, whether pursuant to the Louisiana workers compensation act or otherwise, under any circumstance. The parties also hereby agree that the state of Louisiana, its departments, agencies, agents and employees shall in
NO CIRCUMSTANCE BE, OR CONSIDERED AS, THE EMPLOYER OR STATUTORY EMPLOYER
OF CONTRACTOR, ITS OWNERS, AGENTS AND EMPLOYEES. THE PARTIES FURTHER AGREE
THAT CONTRACTOR IS A WHOLLY INDEPENDENT CONTRACTOR AND IS EXCLUSIVELY
RESPONSIBLE FOR ITS EMPLOYEES, OWNERS, AND AGENTS. CONTRACTOR HEREBY
AGREES TO PROTECT, DEFEND, INDEMNIFY AND HOLD THE STATE OF LOUISIANA, ITS
DEPARTMENTS, AGENCIES, AGENTS AND EMPLOYEES HARMLESS FROM ANY SUCH
ASSERTION OR CLAIM THAT MAY ARISE FROM THE PERFORMANCE OF THIS CONTRACT.

INDEMNIFICATION/HOLD HARMLESS AGREEMENT

CONTRACTOR AGREES TO PROTECT, DEFEND, INDEMNIFY, SAVE, AND HOLD
HARMLESS, THE STATE OF LOUISIANA, ALL STATE DEPARTMENTS, AGENCIES,
BOARDS AND COMMISSIONS, ITS OFFICERS, AGENTS, SERVANTS, EMPLOYEES, AND
VOLUNTEERS, FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, EXPENSES,
AND LIABILITY ARISING OUT OF INJURY OR DEATH TO ANY PERSON OR THE DAMAGE,
LOSS OR DESTRUCTION OF ANY PROPERTY WHICH MAY OCCUR, OR IN ANY WAY GROW
OUT OF, ANY ACT OR OMISSION OF CONTRACTOR, ITS AGENTS, SERVANTS, AND
EMPLOYEES, OR ANY AND ALL COSTS, EXPENSES AND/OR ATTORNEY FEES INCURRED BY
CONTRACTOR AS A RESULT OF ANY CLAIMS, DEMANDS, SUITS OR CAUSES OF ACTION,
EXCEPT THOSE CLAIMS, DEMANDS, SUITS, OR CAUSES OF ACTION ARISING OUT OF THE
NEGLIGENCE OF THE STATE OF LOUISIANA, ALL STATE DEPARTMENTS, AGENCIES,
BOARDS, COMMISSIONS, ITS OFFICERS, AGENTS, SERVANTS, EMPLOYEES AND
VOLUNTEERS.

CONTRACTOR AGREES TO INVESTIGATE, HANDLE, RESPOND TO, PROVIDE DEFENSE
FOR AND DEFEND ANY SUCH CLAIMS, DEMANDS, SUITS, OR CAUSES OF ACTION AT
ITS SOLE EXPENSE AND AGREES TO BEAR ALL OTHER COSTS AND EXPENSES
RELATED THERETO, EVEN IF THE CLAIMS, DEMANDS, SUITS, OR CAUSES OF ACTION ARE
GROUNDLESS, FALSE OR FRAUDULENT.
INDEMNIFICATION AGREEMENT

The ______________________ agrees to protect, defend, indemnify, save, and hold harmless the
Contractor/Subcontractor/Lessee/Supplier

State of Louisiana, all State Departments, Agencies, Boards and Commissions, its officers, agents, servants and
employees, including volunteers, from and against any and all claims, demands, expense, and liability arising out of
injury or death to any person or the damage, loss or destruction of any property which may occur in or any way grow
out of any act or omission of ______________________ its agents, servants, and employees, or any

and all cost, expenses and/or attorney fees incurred by ______________________ as a result of any

claim, demands, and/or causing of action except those claims, demands, and/or causes of action arising out of the
negligence of the State of Louisiana, all State Departments, Agencies, Boards, Commissions, its agents,
representatives, and/or employees. ______________________ agrees to investigate, handle,

respond to, provide defense for and defend any such claims, demand, or suit at its sole expense and agrees to bare all
other costs and expenses related thereto, even it (claims, etc.) is groundless, false or fraudulent.

Accepted by ______________________

Company Name

____________________________

Signature

____________________________

Title

Date Accepted ______________________

Is Certificate of Insurance Attached? ______ Yes ______ No

Contract No. _____________ for __________________________________________ State Agency Number and Name

PURPOSE OF CONTRACT: __________________________________________

BF-11
**Civil Rights**

Both parties shall abide by the requirements of Title VII of the Civil Rights Act of 1964, and shall not discriminate against employees or applicants due to color, race, religion, sex, handicap or national origin. Furthermore, both parties shall take Affirmative Action pursuant to Executive Order #11246 and the National Vocational Rehabilitation Act of 1973 to provide for positive posture in employing and upgrading persons without regard to race, color, religion, sex, handicap or national origin, and shall take Affirmative Action as provided in the Vietnam Era Veteran's Readjustment Act of 1974. Both parties shall also abide by the requirements of Title VI of the Civil Rights Act of 1964 and the Vocational Rehabilitation Act of 1973 to ensure that all services are delivered without discrimination due to race, color, national origin or handicap.

**Anti-Kickback Clause**

The Contractor hereby agrees to adhere to the mandate dictated by the Copeland "Anti-Kickback" Act which provides that each Contractor or sub-grantee shall be prohibited from inducing, by any means, any person employed in the completion of work, to give up any part of the compensation to which he is otherwise entitled.

**Clean Air Act**

The Contractor hereby agrees to adhere to the provisions which require compliance with all applicable standards, orders or requirements issued under Section 306 of the Clean Air Act which prohibits the use under non-exempt Federal contracts, grants or loans of facilities included on the EPA list of Violating Facilities.

**Energy Policy and Conservation Act**

The Contractor hereby recognizes the mandatory standards and policies relating to energy efficiency which are contained in the State energy conservation plan issued in compliance with the Energy Policy and Conservation Act (P.L. 94-163).

**Clean Water Act**

The Contractor hereby agrees to adhere to the provisions which require compliance with all applicable standards, orders, or requirements issued under Section 508 of the Clean Water Act which prohibits the use under non-exempt Federal contracts, grants or loans of facilities included on the EPA List of Violating Facilities.

**Anti-Lobbying and Debarment Act**

The Contractor will be expected to comply with Federal statutes required in the Anti-Lobbying Act and the Debarment Act.

**CANCELLATION**

THE STATE OF LOUISIANA RESERVES THE RIGHT TO CANCEL THIS CONTRACT WITH THIRTY (30) DAYS WRITTEN NOTICE.

**PRICES**

The bidder must state the prices (written in ink, in figures) for which he proposes to furnish each item and shall show the total extended amount for each based on the quantities shown. In case, however, of conflict between the unit price and the extended amount, the unit price shall govern. Unit prices should be inclusive.
of any freight charges. The owner reserves the right to remove any item by deductive change order at the same amount that is indicated on the submitted bid form.

**F. O. B.**
Bid should be FOB Destination/Agency, title passing upon acceptance of merchandise. Failure to comply with this requirement may disqualify your bid.

**STANDARD OF QUALITY**
Any product or service bid shall conform to all applicable Federal and State laws and regulations and the specifications contained in the IFB. Unless otherwise specified in the IFB, any manufacturer’s name, trade name, brand, name, or catalog number used in the specifications is for the purpose of describing the quality level and characteristic required. Bidder must specify the brand and model number of the product offered in his bid. Bids not specifying brand and model number shall be considered as offering the exact products specified in the IFB.

**DESCRIPTIVE INFORMATION**
Bidders proposing an equivalent brand or model should submit the information 10 days prior to Bid Date (such as illustrations, descriptive literature, technical data) sufficient for NSU Purchasing to evaluate quality, suitability, and compliance with the specifications in the IFB. Failure to submit descriptive information for approval may cause bid to be rejected. Any change made to a manufacturer’s published specifications submitted for a product shall be verifiable by the manufacturer.

**MANUFACTURER’S NUMBERS AND TRADE NAMES**
Where manufacturer’s products is named or specified, it is understood that “or equal” shall apply, whether stated or not. Such name and number is meant to establish the standard, type, quality, style, etc. Northwestern State University shall be the sole judges as to whether or not the equipment offered is equal to that specified.

**BID OPENING**
Bidders may attend the bid opening, but no information or opinions concerning the ultimate contract award will be given at the bid opening or during the evaluation process. Bids may be examined 72 hours after request is made. Information pertaining to completed files may be secured by visiting Northwestern State University Purchasing during normal working hours. Written bid tabulations will not be furnished.

**AWARD**
Award will be made to the lowest responsible bidder, taking into consideration the quality of the products to be supplied, their conformity with specifications, the purposes for which they are required, and the time for delivery. Northwestern State University of Louisiana reserves the right to award items separately, grouped or on an all-or-none basis and to reject any or all bids and waive any informalities.

**PURCHASE ORDER**
If any bid or bids are accepted, an initial purchase order or orders for the entire number of units or part thereof will be issued not later than thirty (30) days after receipt of bids by the Owner to the lowest bidder offering products which, in the opinion of the University, meet the requirements of these specifications.

**CONDITIONS OF PURCHASE ORDERS**
We will not in any manner be responsible for goods delivered or work done for our account without a written order. No allowance for boxing or crating. If you cannot fill order as directed, return for advice. Quantities in excess of the order may be returned or held subject to shipper’s order, expense and risk. By accepting the order, you hereby warrant that the merchandise to be furnished hereunder will be full conformity with the
specifications, drawing or sample and agree that this warrant shall survive acceptance of the merchandise and that you bear the cost of inspecting merchandise rejected.

**PAYMENT TERMS**
Payments will be made 20 days after approved receipt of Contractor’s Pay Request outlining work performed and balance of work to be performed. A 5% Retainage will be held until the end of the 45 day Lein Period starting upon completion of the project. Invoices shall be submitted to: Northwestern State University, Business Affairs, Accounts Payable Section, St. Denis Hall, Natchitoches, LA. 71497. We must pay from ORIGINAL, ITEMIZED invoices as required by the State Legislative Auditor.

**U.S. TAXPAYER IDENTIFICATION NUMBER**
Enter your taxpayer identification number in the appropriate space on the Specification and Bid Form Page. For individuals and sole proprietors, this is your social security number. For other entities, it is your employer identification number. PAYMENT CANNOT BE PROCESSED WITHOUT YOUR TAX I.D. NUMBER.

**TAXES**
The State is exempt from sales/use tax. Vendor is responsible for including all applicable taxes in the bid price.

**NEW PRODUCTS**
Unless specifically called for in the IFB, all products for purchase must be new, never previously used, and the current model and/or packaging. No remanufactured, demonstrator, used or irregular product will be considered for purchase unless otherwise specified in the IFB. The manufacturer’s standard warranty will apply unless specified in the IFB.

**CONTRACT CANCELLATION**
Northwestern State University reserves the right to cancel this contract with thirty (30) days written notice.

**DEFAULT OF CONTRACTOR**
Failure to deliver within the time specified in the bid will constitute a default and may cause cancellation of the contract. Where the Northwestern State University Purchasing has determined the contractor to be in default, NSU Purchasing reserves the right to purchase any or all products or services covered by the contract on the open market and to charge the contractor with cost in excess of the contract price. Until such assessed charges have been paid, so subsequent bid from the defaulting contractor will be considered.

**Davis Bacon Act:** The Davis-Bacon Act, United States Code, Title 40, Chapter 3, Section 276(a) requires all laborers and mechanics employed by contractors and subcontractors who work on construction projects financed by federal assistance to be paid wages not less than those established by the Secretary of Labor for the locality of the project when required by federal grant program legislation.

**ORDER OF PRIORITY**
In the event there is a conflict between the Instructions to Bidders or General Conditions and the General Conditions and the Special Conditions, the Special Conditions shall govern.

**APPLICABLE LAW**
All contracts shall be construed in accordance with and governed by the laws of the State of Louisiana.

**EEOC COMPLIANCE**
The contractor agrees to abide by the requirements of the following as applicable: Title VI and VII of the Civil Rights Act of 1964, as amended by the Equal Opportunity Act of 1972, Federal Executive Order
11246, the Federal Rehabilitation Act of 1973, as amended, the Vietnam Era Veteran’s Readjustment Assistance Act of 1974, Title IX of the Education Amendments of 1972, the Age Act of 1972, and contractor agrees to abide by the requirements of the Americans With Disabilities Act of 1990: Contractor agrees not to discriminate in its employment practices, and will render services under this contract without regard to race, color, religion, sex, national origin, veteran status, political affiliation, disabilities, or in accordance with KBB 2004-54 because of an individual’s sexual orientation. Any act of discrimination committed by Contractor, or failure to comply with these statutory obligations when applicable shall be grounds for termination of this contract.

METHOD OF AWARD – LOWEST QUALIFIED BIDDER: If at the time the contract is to be awarded, the lowest base bid submitted by a responsible bidder, does not exceed the amount of funds then estimated by the Owner as available to finance the project, the contract will be awarded.

COMPLETION TIME: The Bidder hereby agrees to commence work under this Contract on a date specified in a written “Notice to Proceed” by the Owner and to fully complete the project within (120) One hundred twenty days consecutive calendar days thereafter, or within the time as may be extended as stipulated in the Contract Documents.

LIQUIDATED DAMAGES: The Bidder hereby also agrees to pay as Liquidated damages the sum of $500.00 Dollars for each consecutive calendar day, which the work is not complete, beginning with the first day beyond the completion time, stated above.

AWARD AND EXECUTION OF CONTRACT: When this project is financed either partially or entirely with State Bonds, the award of this Contract is contingent upon the sale of bonds by the State Bond Commission. The State shall incur no obligation to the Contractor until the Contract between Owner and Contractor is duly executed.

If the Bidder is notified of the acceptance of the bid within thirty (30) days after the opening of bids, he agrees to execute and deliver the “Contract Between Owner and Contractor and Performance and Payment Bond, a copy of which is attached to the Contract Documents within ten (10) days after notice from the Owner that the instrument is ready for signature.

REJECTION OF BIDS: The Bidder understands that the Owner reserves the right to reject any or all bids for just cause. In accordance with La. R.S. 38:2212(A) (1) (b), the provisions and requirements of this Section, those stated in the advertisement for bids, and those required on the bid form shall not be considered as informalities and shall not be waived by any public entity.

WITHDRAWAL OF BIDS: The Bidder agrees that this bid shall be good and may not be withdrawn for a period of thirty (30) calendar days after the scheduled closing time for receiving bids except in accordance with the provisions of R.S. 38:2214. This bid may be withdrawn at any time prior to the scheduled time for the opening of bids or any authorized postponement thereof.

LICENSED CONTRACTOR: If total bid is fifty thousand dollars ($50,000.00) or more only bidders holding a valid license with the State of Louisiana Board for Contractors for any of the following licenses will be considered a valid bidder: General Contractor.

STANDARD PREFERENCE: In accordance with Louisiana Revised Statutes 39:1595, a preference not to exceed 7% may be allowed for products manufactured, produced, grown or assembled in Louisiana of equal quality. (4% if meat or seafood, further processed.)
Do you claim this preference? Yes________________

Specify Preference % and Item Number (s): _____________________________________________

Where Items are Produced / Manufactured: _____________________________________________

(Note: If more space is required, include on separate sheet. Failure to specify above information may cause elimination from standard preference. NOTE: No preference will apply to service contracts.)

**SCOPE OF CONTRACT**

Furthermore, submittal of any terms and conditions contrary to those of the State of Louisiana may cause your bid to be rejected. By signing this form terms and conditions which may be included in your bid are nullified, and contractor agrees that this contract shall be construed in accordance with and governed by the laws of the State of Louisiana.

(Members of firm or person authorized to sign bids for corporation)

**BIDDERS MUST SIGN IN INK**
NSU Student Union Student Activities Area  
Name of Project  
Sealed Bid # 7594  
Project No.  

ATTESTATIONS  

Appeare, as a Bidder on the above-entitled Public Works Project, does hereby attest that:

LA. R.S. 38:2227 PAST CRIMINAL CONVICTIONS OF BIDDERS

A. No sole proprietor or individual partner, incorporator, director, manager, officer, organizer, or member who has a minimum of a ten percent (10%) ownership in the bidding entity named below has been convicted of, or has entered a plea of guilty or nolo contendere to any of the following state crimes or equivalent federal crimes:

(a) Public Bribery (R.S. 14:118)  
(b) Corrupt influencing (R.S. 14:120)  
(c) Extortion (R.S. 14:66)  
(d) Money Laundering (R.S. 14:23)

B. Within the past five years from the project bid date, no sole proprietor or individual partner, incorporator, director, manager, officer, organizer who has a minimum of a ten percent (10%) ownership in the bidding entity named below has been convicted of, or has entered a plea of guilty or nolo contendere to any of the following state crimes or equivalent federal crimes, during the solicitation or execution of a contract or bid awarded pursuant to the provisions of Chapter 10 of Title 38 of the Louisiana Revised Statutes:

(a) Theft (R.S. 14:67)  
(b) Identity Theft (R.S. 14:67.16)  
(c) Theft of a business record (R.S. 14:67.20)  
(d) False Accounting (R.S. 14:70)  
(e) Issuing worthless checks (R.S. 14:71)  
(f) Bank fraud (R.S. 14:71.1)  
(g) Forger (R.S. 14:72)  
(h) Contractors; misapplication of payments (R.S. 14:202)  
(i) Malfeasance in office (R.S. 14:134)

LA. R.S. 38:2212.10 Verification of Employees

A. At the time of bidding, Appeare is registered and participates in a status of verification system to verify that all new hires in the State of Louisiana are legal citizens of the United States or are legal aliens.

B. If awarded the contract, Appeare shall continue, during the term of the contract, to utilize a status verification system to verify the legal status of all new employees in the State of Louisiana.

C. If awarded the contract, Appeare shall require all subcontractors to submit to it a sworn affidavit verifying compliance with Paragraphs (A) and (B) of this Subsection.

<table>
<thead>
<tr>
<th>NAME OF BIDDER</th>
<th>NAME OF AUTHORIZED SIGNATORY OF BIDDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE</td>
<td>TITLE OF AUTHORIZED SIGNATORY OF BIDDER</td>
</tr>
</tbody>
</table>

SIGNATURE OF AUTHORIZED SIGNATORY OF BIDDER
ON-SITE VISIT/INSPECTION FORM

I, ____________________________________________________, have made an on-site visit to Northwestern State University and made a complete inspection of the area indicated as the project limits in the Construction Documents and understand all Requirements to perform the specifications of Bid # SB#7594.

FOR BIDDER: _______________________________    _________________
              Signature    Date

FOR NSU:   _______________________________    _________________
            Physical Plant Representative    Date

NOTE: THIS MUST BE COMPLETED, SIGNED AND RETURNED WITH BID.
TO:  Northwestern State University of Louisiana
NSU St. Denis Hall
Business Affairs, Purchasing
200 Sam Sibley Dr.
Natchitoches, LA 71497
(Owner to provide name of entity preparing bidding documents.)

BID FOR:  Northwestern State University of Louisiana
Sealed Bid #7594

TO:  Northwestern State University of Louisiana
NSU St. Denis Hall
Business Affairs, Purchasing
200 Sam Sibley Dr.
Natchitoches, LA 71497
(Owner to provide name of entity preparing bidding documents.)

The undersigned bidder hereby declares and represents that she/he; a) has carefully examined and understands the Bidding Documents, b) has not received, relied on, or based his bid on any verbal instructions contrary to the Bidding Documents or any addenda, c) has personally inspected and is familiar with the project site, and hereby proposes to provide all labor, materials, tools, appliances and facilities as required to perform, in a workmanlike manner, all work and services for the construction and completion of the referenced project, all in strict accordance with the Bidding Documents prepared by: Sutton Beebe Babin Architects, LLC and dated: June 5, 2019.

Bidders must acknowledge all addenda. The Bidder acknowledges receipt of the following ADDENDA: (Enter the number the Designer has assigned to each of the addenda that the Bidder is acknowledging)

TOTAL BASE BID: For all work required by the Bidding Documents (including any and all unit prices but not alternates) the sum of:

Dollars ($________________________ )

ALTERNATES: For any and all work required by the Bidding Documents for Alternates including any and all unit prices designated as alternates in the unit price description.

Alternate No. 1 Add the cost to remove and replace AHU #9 and AHU #13 for the lump sum of:

Dollars ($________________________ )

Alternate No. 2 (Owner to provide description of alternate and state whether add or deduct) for the lump sum of:

Dollars ($________________________ )

Alternate No. 3 (Owner to provide description of alternate and state whether add or deduct) for the lump sum of:

Dollars ($________________________ )

NAME OF BIDDER: ________________________________________________________________________

ADDRESS OF BIDDER: __________________________________________________________________
________________________________________________________________

LOUISIANA CONTRACTOR’S LICENSE NUMBER: ___________________________________________

NAME OF AUTHORIZED SIGNATORY OF BIDDER: ___________________________________________

TITLE OF AUTHORIZED SIGNATORY OF BIDDER: ___________________________________________

SIGNATURE OF AUTHORIZED SIGNATORY OF BIDDER **:__________________________________________

DATE: _______________________

* The Unit Price Form shall be used if the contract includes unit prices. Otherwise it is not required and need not be included with the form. The number of unit prices that may be included is not limited and additional sheets may be included if needed.

** If someone other than a corporate officer signs for the Bidder/Contractor, a copy of a corporate resolution or other signature authorization shall be required for submission of bid. Failure to include a copy of the appropriate signature authorization, if required, may result in the rejection of the bid unless bidder has complied with La. R.S. 38:2212(A)(1)(c) or RS 38:2212(O).
BID BOND
FOR
NORTHWESTERN STATE UNIVERSITY PUBLIC WORKS PROJECTS

Date: ________________

KNOW ALL MEN BY THESE PRESENTS:

That __________________________, as Principal, and __________________________, as Surety, are held and firmly bound
unto the State of Louisiana, Northwestern State University (Obligee), in the full and just sum of five (5%) percent of
the total amount of this proposal, including all alternates, lawful money of the United States, for payment of which
sum, well and truly be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly
and severally firmly by these presents.

Surety represents that it is listed on the current U. S. Department of the Treasury Financial Management
Service list of approved bonding companies as approved for an amount equal or greater than the amount for which it
obligates itself in this instrument or that it is a Louisiana domiciled insurance company with at least an A - rating in the
latest printing of the A. M. Best's Key Rating Guide. If surety qualifies by virtue of its Best's listing, the Bond amount
may not exceed ten percent of policyholders' surplus as shown in the latest A. M. Best's Key Rating Guide.

Surety further represents that it is licensed to do business in the State of Louisiana and that this Bond is signed
by surety's agent or attorney-in-fact. This Bid Bond is accompanied by appropriate power of attorney.

THE CONDITION OF THIS OBLIGATION IS SUCH that, whereas said Principal is herewith submitting its
proposal to the Obligee on a Contract for:

NSU Student Union Student Activities Area, SB#7594

NOW, THEREFORE, if the said Contract be awarded to the Principal and the Principal shall, within such time
as may be specified, enter into the Contract in writing and give a good and sufficient bond to secure the performance of
the terms and conditions of the Contract with surety acceptable to the Obligee, then this obligation shall be void;
otherwise this obligation shall become due and payable.

______________________________  ______________________________
PRINCIPAL (BIDDER)            SURETY

BY: ___________________________  BY: ____________________________
AUTHORIZED OFFICER-OWNER-PARTNER  AGENT OR ATTORNEY-IN-FACT(SEAL)
NOTIFICATION LETTER

To: All contractors, subcontractors and short-term workers working or proposing to work on the campus of Northwestern State University.

The state of Louisiana has completed an asbestos survey of all state-owned buildings. The results of the survey are compiled in management plans by facility. The management plans were assembled according to the requirements set forth in the Department of Environmental Quality Required Elements Index. These plans are available for review to anyone interested in the results. The plans will be kept in the Office of Environmental Health and Safety Officer at 998 South Jefferson Street, Natchitoches, Louisiana.

Designated person to carry out local education agency, Northwestern State University, responsibilities under LAC 33:III.2705:

Northwestern State University Environmental Health & Safety Officer, Chelsea Eddington (318) 357-4424 Per LAC 33:III, Chapter 27, Louisiana Asbestos Regulations, this information is available for your review to ensure that all “workers who may come in contact with asbestos in a school or state building are provided information regarding the locations of ACBM and suspected ACBM assumed to be a ACM.

All contractors, subcontractors and short-term workers planning to do any work on any Northwestern Campus shall coordinate with the Environmental Health and Safety Officer prior to beginning such work.

All other issues will be coordinated by contacting Utilities Superintendent, Jon Lentz or Director of Physical Plant and Facilities, Dale Wohletz at the Facilities Services Complex at 998 South Jefferson Street, Natchitoches, Louisiana (318)-357-5881 or (318) 357-5066.
DIVISION II

GENERAL REQUIREMENTS
PART 1 - GENERAL

1.1 PROJECT INFORMATION

A. Project Identification: NSU Student Union Student Activities Area.

1. Project Location: Northwestern State University of Louisiana, Natchitoches, LA, Friedman Student Union Building.

B. Owner: Northwestern State University.

C. Architect: Sutton Beebe Babin Architects, LLC; 333 Texas Street, Suite 1200, Shreveport, LA, 71101; phone: 318.221.1623.

D. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Mechanical, Plumbing, and Electrical Engineer: John J. Guth Associates, Inc.; 208 Milam Street, Shreveport, LA, 71101; phone: 318.221.8638.


1.2 WORK RESTRICTIONS

A. Contractor's Use of Premises: During construction, Contractor will have limited use of site and building indicated. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project and as follows:

1. Owner will occupy premises during construction. The building is occupied by staff and students. Staff hours are from 8:00 am to 5:00 pm. Students may utilize portions of the building at other times. The building houses special events which may occur during the construction project. These events are mainly on the Second Floor. Coordinate with Owner's Representative for after-hours work.

2. Driveways, Walkways, and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

B. On-Site Work Hours: Work in the existing building can be performed beyond normal work hours. Contractor to access only areas required to perform work.

C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

D. Staging:

1. Staging for the work will be in the back of the building.

2. Provide fencing for storage of material, tools, etc. that is stored on site.

3. Owner is not responsible for Contractor's materials or tools.

4. Provide protection of existing finishes at path from staging area to work site.

5. Clean common areas daily or more often if necessary, to prevent tracking and spreading of dust and debris into non-work areas of the building.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000
SECTION 012000 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 PAYMENT PROCEDURES

A. Submit a Schedule of Values at least seven days before the initial Application for Payment. Break down the Contract Sum into at least one line item for each Specification Section in the Project Manual table of contents. Coordinate the schedule of values with Contractor's construction schedule.

1. Arrange schedule of values consistent with format of AIA Document G703.
2. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
4. Provide separate line items in the schedule of values for initial cost of materials and for total installed value of that part of the Work.

B. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

C. Submit three copies of each application for payment.

1. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor.
2. With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
3. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

   a. Include insurance certificates, proof that taxes, fees, and similar obligations were paid, and evidence that claims have been settled.
   b. Include affidavit of payment of debts and claims on AIA Document G706.
   c. Include affidavit of release of liens on AIA Document G706A.
   d. Include consent of surety to final payment on AIA Document G707.
   e. Submit final meter readings for utilities, a record of stored fuel, and similar data as of the date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012000
SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 CONTRACT MODIFICATION PROCEDURES

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

B. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work.
   1. Proposal Requests are not instructions either to stop work in progress or to execute the proposed change.
   2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time.

C. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

D. On Owner’s approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701, for all changes to the Contract Sum or the Contract Time.

   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

F. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600
SECTION 013000 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 PROJECT MANAGEMENT AND COORDINATION

A. Subcontract List: Submit a written summary identifying individuals or firms proposed for each portion of the Work.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. List e-mail addresses and telephone numbers.

C. Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.

D. Requests for Information (RFIs): On discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI. Use forms acceptable to Architect and Owner.

E. Schedule and conduct progress meetings at Project site at weekly intervals. Notify Owner and Architect of meeting dates and times. Require attendance of each subcontractor or other entity concerned with current progress or involved in planning, coordination, or performance of future activities.

1.2 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings can be provided by Architect for Contractor's use in preparing submittals.

   a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
   b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to the Architect.

B. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

1. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
2. Architect will return submittals, without review, received from sources other than Contractor.

C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with unique identifier, including project identifier, Specification Section number, and revision identifier.
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

D. Identify options requiring selection by Architect.

E. Identify deviations from the Contract Documents on submittals.

F. Contractor's Construction Schedule Submittal Procedure:

1. Submit required submittals in the following format:
   a. PDF electronic file.
2. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
a. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

3. Coordinate Contractor’s construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

2.2 ACTION SUBMITTALS

A. Product Data: Mark each copy to show applicable products and options. Include the following:

1. Manufacturer’s written recommendations, product specifications, and installation instructions.
2. Wiring diagrams showing factory-installed wiring.
3. Printed performance curves and operational range diagrams.
4. Testing by recognized testing agency.
5. Compliance with specified standards and requirements.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Submit on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (762 by 1067 mm). Include the following:

1. Dimensions and identification of products.
2. Fabrication and installation drawings and roughing-in and setting diagrams.
3. Wiring diagrams showing field-installed wiring.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.

C. Samples: Submit Samples for review of kind, color, pattern, and texture and for a comparison of these characteristics between submittal and actual component as delivered and installed. Include name of manufacturer and product name on label.

1. If variation is inherent in material or product, submit at least three sets of paired units that show variations.

2.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Product Certificates: Prepare written statements on manufacturer’s letterhead certifying that product complies with requirements in the Contract Documents.

2.4 CONTRACTOR’S CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type schedule within 15 days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
C. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

D. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and indicate date by which recovery will be accomplished.

PART 3 - EXECUTION

3.1 SUBMITTAL REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Architect will review each action submittal, make marks to indicate corrections or modifications required, will stamp each submittal with an action stamp, and will mark stamp appropriately to indicate action.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.2 CONTRACTOR’S CONSTRUCTION SCHEDULE

A. Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule before each regularly scheduled progress meeting.

1. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribute copies of approved schedule to Owner, Architect, subcontractors, testing and inspecting agencies, and parties identified by Contractor with a need-to-know schedule responsibility. When revisions are made, distribute updated schedules to the same parties.

END OF SECTION 013000
SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Use Charges: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated.

B. Water and Electric Power: Available from Owner's existing system without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts and top and bottom rails.

2.2 TEMPORARY FACILITIES

A. Provide field offices, storage and fabrication sheds, and other support facilities as necessary for construction operations. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

C. Heating and Cooling: Provide temporary heating and cooling required for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
D. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

3.2 SUPPORT FACILITIES INSTALLATION
A. Install project identification and other signs in locations approved by Owner to inform the public and persons seeking entrance to Project.
C. Temporary Elevator Use: Use of elevators is not permitted.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION
A. Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
B. Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
C. Install and maintain temporary fire-protection facilities. Comply with NFPA 241.

3.4 OPERATION, TERMINATION, AND REMOVAL
A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
B. Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion.
C. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period.

END OF SECTION 015000
SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

B. Comparable Product Requests: Submit request during Bidding Phase only for consideration of each comparable product. Identify product or fabrication or installation method to be replaced.
   1. Show compliance with requirements for comparable product requests.
   2. Architect will review the proposed product and notify Contractor of its acceptance or rejection.

C. Basis-of-Design Product Specification Submittal: Show compliance with requirements.

D. Compatibility of Options: If Contractor is given option of selecting between two or more products, select product compatible with products previously selected.

E. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Deliver products to Project site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
   4. Store materials in a manner that will not endanger Project structure.
   5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

F. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. Provide products that comply with the Contract Documents, are undamaged, and, unless otherwise indicated, are new at the time of installation.
   1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.
   2. Where products are accompanied by the term "as selected," Architect will make selection.

B. Where the following headings are used to list products or manufacturers, the Contractor's options for product selection are as follows:
   1. Products:
      a. Where requirements include "one of the following," provide one of the products listed that complies with requirements.
      b. Where requirements do not include "one of the following," provide one of the products listed that complies with requirements or a comparable product.
   2. Manufacturers:
a. Where requirements include "one of the following," provide a product that complies with requirements by one of the listed manufacturers.

b. Where requirements do not include "one of the following," provide a product that complies with requirements by one of the listed manufacturers or another manufacturer.

3. Basis-of-Design Product: Provide the product named, or indicated on the Drawings, or a comparable product by one of the listed manufacturers.

C. Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

D. Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Architect will consider Contractor's request for comparable product when the following conditions are satisfied:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications.
3. List of similar installations for completed projects, if requested.
4. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000
SECTION 017000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 EXECUTION REQUIREMENTS

A. Cutting and Patching:
   2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
   3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.2 CLOSEOUT SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
B. Certified List of Incomplete Items: Final submittal at Final Completion.
C. Operation and Maintenance Data: Submit three copies of manual.
E. Record Drawings: Submit one set(s) of marked-up record prints.
F. Record Product Data: Submit three paper copies and annotated PDF electronic files and directories of each submittal to be included in Operation and Maintenance Manual.

1.3 SUBSTANTIAL COMPLETION PROCEDURES

A. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.

B. Submittals Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:
   1. Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   2. Submit closeout submittals specified in other sections, including project record documents, operation and maintenance manuals, property surveys, similar final record information, warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   3. Submit maintenance material submittals specified in other sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect.
   4. Submit test/adjust/balance records.
   5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:
   1. Advise Owner of pending insurance changeover requirements.
   2. Make final changeover of permanent locks and deliver keys to Owner.
   3. Complete startup and testing of systems and equipment.
   4. Perform preventive maintenance on equipment used prior to Substantial Completion.
   5. Advise Owner of changeover in heat and other utilities.
6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
7. Remove temporary facilities and controls.
8. Complete final cleaning requirements, including touchup painting.
9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will proceed with inspection or advise Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

1.4 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting inspection for determining final completion, complete the following:

1. Submit a final Application for Payment.
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare final Certificate for Payment after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

B. Cleaning Agents: Use cleaning materials and agents recommended by 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.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

2.2 OPERATION AND MAINTENANCE DOCUMENTATION

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. Organization: Unless otherwise indicated, organize manual into separate sections for each system and subsystem, and separate sections for each piece of equipment not part of a system.

C. Organize data into three-ring binders with identification on front and spine of each binder, and envelopes for folded drawings. Include the following:

1. Manufacturer's operation and maintenance documentation.
2. Maintenance and service schedules.
3. Maintenance service contracts. Include name and telephone number of service agent.
4. Emergency instructions.
5. Spare parts list and local sources of maintenance materials.
6. Wiring diagrams.
7. Copies of warranties. Include procedures to follow and required notifications for warranty claims.
2.3 RECORD DRAWINGS

A. Record Prints: Maintain a set of prints of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Mark to show actual installation where installation varies from that shown originally. Accurately record information in an acceptable drawing technique.

1. Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

B. Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Verify compatibility with and suitability of substrates.
2. Examine roughing-in for mechanical and electrical systems.
3. Examine walls, floors, and roofs for suitable conditions.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Take field measurements as required to fit the Work properly. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.

E. Verify space requirements and dimensions of items shown diagrammatically on Drawings.

F. Surface and Substrate Preparation: Comply with manufacturer's written recommendations for preparation of substrates to receive subsequent work.

3.2 CONSTRUCTION LAYOUT

A. Before proceeding to lay out the Work, verify layout information shown on Drawings.

3.3 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
3. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations.

C. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

D. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed.

E. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.

F. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

G. Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CUTTING AND PATCHING

A. Provide temporary support of work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

D. Cutting: Cut in-place construction using methods least likely to damage elements retained or adjoining construction.

1. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

E. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will minimize evidence of patching and refinishing.
2. Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance.
3. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

3.5 CLEANING

A. Clean Project site and work areas daily, including common areas. Dispose of materials lawfully.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
3. Remove debris from concealed spaces before enclosing the space.

B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion:

1. Clean Project site, yard, and grounds, in areas disturbed by construction activities. Sweep paved areas; remove stains, spills, and foreign deposits. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
2. Sweep paved areas broom clean. Remove spills, stains, and other foreign deposits.
3. Remove labels that are not permanent.
4. Clean transparent materials, including mirrors. Remove excess glazing compounds.
5. Clean exposed finishes to a dust-free condition, free of stains, films, and foreign substances. Sweep concrete floors broom clean.
8. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

3.6 OPERATION AND MAINTENANCE MANUAL PREPARATION

A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
B. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are unavailable and where the information is necessary for proper operation and maintenance of equipment or systems.

C. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams.

3.7 DEMONSTRATION AND TRAINING

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Include a detailed review of the following:

1. Include instruction for basis of system design and operational requirements, review of documentation, emergency procedures, operations, adjustments, troubleshooting, maintenance, and repairs.

END OF SECTION 017000
SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Clean salvaged items and install salvaged items to comply with installation requirements for new materials and equipment.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner’s Use: Clean salvaged items and store in a secure area until delivery to Owner.

D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs.

E. Plumbing Fixtures: Separate by type and size.

F. Lighting Fixtures: Separate lamps by type and protect from breakage.

3.2 DISPOSAL OF WASTE

A. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

B. Do not burn waste materials.

END OF SECTION 017419
DIVISION IV

TECHNICAL SPECIFICATIONS
SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Items indicated to be removed and salvaged remain Owner's property. Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

B. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

C. It is not expected that hazardous materials will be encountered in the Work. If hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with EPA regulations and 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 DEMOLITION

A. Maintain services/systems indicated to remain and protect them against damage during selective demolition operations. Before proceeding with demolition, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of the building.

B. Locate, identify, shut off, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

D. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

E. Protect walls, ceilings, floors, and other existing finish work that are to remain. Erect and maintain dustproof partitions. Cover and protect furniture, furnishings, and equipment that have not been removed.

F. 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.

G. Provide temporary weather protection to prevent water leakage and damage to structure and interior areas.

H. Requirements for Building Reuse:

1. Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
2. Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

I. 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.

J. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill. Do not burn demolished materials.

K. 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 024119
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and concrete mix designs.

B. Ready-Mixed Concrete Producer Qualifications: ASTM C 94/C 94M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS


2.2 MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Portland Cement: ASTM C 150, Type I.

C. Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded, with at least 10 years' satisfactory service in similar applications.
   1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.


E. Chemical Admixtures: ASTM C 494, water reducing water reducing and retarding. Do not use calcium chloride or admixtures containing calcium chloride.

F. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

H. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.3 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301.

B. Normal-Weight Concrete:
   1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.50.
   3. Slump Limit: 4 inches (100 mm) plus or minus 1 inch (25 mm).
   4. Air Content: Maintain within range permitted by ACI 301.

C. Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116.
   1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
PART 3 - EXECUTION

3.1 CONCRETING

A. Construct formwork according to ACI 301 and maintain tolerances and surface irregularities within ACI 347R limits of Class A, 1/8 inch (3.2 mm) for concrete exposed to view.

B. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

C. Install construction, isolation, and contraction joints where indicated. Install full-depth joint-filler strips at isolation joints.

D. Place concrete in a continuous operation and consolidate using mechanical vibrating equipment.

E. Protect concrete from physical damage, premature drying, and reduced strength due to hot or cold weather during mixing, placing, and curing.

F. Formed Surface Finish: Smooth-formed finish for concrete exposed to view, coated, or covered by waterproofing or other direct-applied material; rough-formed finish elsewhere.

G. Cure formed surfaces by moisture curing for at least seven days.

H. Begin curing concrete slabs after finishing. Keep concrete continuously moist for at least seven days.

I. Owner will engage a testing agency to perform field tests and to submit test reports.

J. Protect concrete from damage. Repair and patch defective areas.

K. Curbs: Provide monolithic finish to curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

END OF SECTION 033000
SECTION 035413 - GYPSUM CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Installer Qualifications: Installer who is approved by manufacturer.

C. Environmental Limitations: Place gypsum-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

PART 2 - PRODUCTS

2.1 GYPSUM-CEMENT-BASED UNDERLAYMENTS

A. Underlayment: Gypsum-cement-based, self-leveling product.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ARDEX Americas.
   b. Bonsal American, an Oldcastle company.
   c. USG Corporation.

2. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.

2. Concrete Substrates: Remove laitance, glaze, curing compounds, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

3.2 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface.

D. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

END OF SECTION 035413

GYPSUM CEMENT UNDERLAYMENT
SBB Project No. 1911.00
SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: ICC-ES evaluation reports for treated wood.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.

2.2 TREATED MATERIALS

A. Preservative-Treated Materials: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Use treatment containing no arsenic or chromium.
2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

B. Provide preservative-treated materials for items indicated on Drawings, and the following:
   1. Wood sills, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
   2. Wood framing members that are less than 18 inches (460 mm) above the ground.

C. Fire-Retardant-Treated Materials: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use Exterior type for exterior locations and where indicated.
2. Use Interior Type A unless otherwise indicated.
3. For enclosed framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with design adjustment factors of not less than 0.85 for modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
4. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
5. Identify with appropriate classification marking of a testing and inspecting agency acceptable to authorities having jurisdiction.

D. Provide fire-retardant treated materials for items indicated on Drawings.

2.3 LUMBER

A. Miscellaneous Dimension Lumber: Construction, or No. 2 grade with 19 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

B. Concealed Boards: Mixed southern pine, No. 2: SPIB with 19 percent maximum moisture content.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, Exterior, C-C Plugged, fire-retardant treated, not less than 3/4-inch (19-mm) nominal thickness.
2.5 FASTENERS

A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.


PART 3 - EXECUTION

3.1 INSTALLATION

A. Set miscellaneous rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Securely attach miscellaneous rough carpentry to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.
2. Table 2304.9.1, “Fastening Schedule,” in the IBC.

END OF SECTION 061053
SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: ICC-ES evaluation reports for fire-retardant-treated plywood.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1.

2.2 TREATED PLYWOOD

A. Fire-Retardant-Treated Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use Exterior type for exterior locations and where indicated.
2. Use Interior Type A unless otherwise indicated.
3. Identify with appropriate classification marking of a testing and inspecting agency acceptable to authorities having jurisdiction.

B. Provide fire-retardant-treated plywood for all plywood.

2.3 SUBFLOORING AND UNDERLAYMENT

A. Combination Subfloor-Underlayment:

1. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exposure 1, Underlayment single-floor panels, with sanded underlayment for resilient flooring installation.
2. Oriented-Stand-Board Combination Subfloor-Underlayment: Exposure 1 single-floor panels.

2.4 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated.

1. For sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.

B. Adhesives for Field Gluing Panels to Framing: APA AFG-01.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in the IBC.
B. Fastening Methods:

1. Combination Subfloor-Underlayment:
   a. Screw to cold-formed metal framing.

END OF SECTION 061600
SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and color Samples.

B. Environmental Limitations: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).

PART 2 - PRODUCTS

2.1 JOINT SEALANTS

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.

B. Sealant for General Exterior Use Where Another Type Is Not Specified, One of the Following:

1. Single-component, nonsag urethane sealant, ASTM C 920, Type S; Grade NS; Class 25; and for Use NT.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) BASF Corporation.
      2) Bostik, Inc.
      3) Pecora Corporation.
      4) Sika Corporation; Joint Sealants.
      5) Tremco Incorporated.

C. Sealant for Interior Use at Perimeters of Door and Window Frames:

1. Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Everkem Diversified Products, Inc.
      2) Pecora Corporation.
      3) Tremco Incorporated.

D. Acoustical Sealant:

1. Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission as demonstrated by testing according to ASTM E 90.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) GE Construction Sealants; Momentive Performance Materials Inc.
      2) Hilti, Inc.
      3) Pecora Corporation.
      4) Tremco Incorporated.
      5) USG Corporation.

2.2 MISCELLANEOUS MATERIALS

A. Provide sealant backings of materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
B. Cylindrical Sealant Backings: ASTM C 1330, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

D. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with ASTM C 1193.

B. Install sealant backings to support sealants during application and to produce cross-sectional shapes and depths of installed sealants that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal perimeters, control joints, openings, and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions. Comply with ASTM C 919.

END OF SECTION 079200
SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Shop Drawings.

PART 2 - PRODUCTS

2.1 HOLLOW METAL FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amweld International, LLC.
2. Ceco Door; ASSA ABLOY.
3. MPI Group, LLC (The).
4. Steelcraft; an Allegion brand.

B. Frames: ANSI A250.8; conceal fastenings unless otherwise indicated.

1. Steel Sheet for Interior Frames: 0.053-inch- (1.3-mm-) minimum thickness.
2. Interior Frame Construction: Knocked down.
3. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.
4. Frame Anchors: Not less than 0.042 inch (1.0 mm) thick.

C. Door Silencers: Three on strike jambs of single-door frames and two on heads of double-door frames.

D. Prepare frames to receive mortised and concealed hardware according to SDI A250.6 and BHMA A156.115.

E. Reinforce frames to receive surface-applied hardware.

F. Prime Finish: Manufacturer’s standard, factory-applied coat of lead- and chromate-free primer complying with SDI A250.10 acceptance criteria.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, suitable for exposed applications.

B. Frame Anchors: ASTM A 879/A 879M, 4Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, sheet steel 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.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hollow metal frames to comply with SDI A250.11.

1. Fire-Rated Frames: Install according to NFPA 80.
B. 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. Use galvanizing repair paint for metallic coated surfaces.

END OF SECTION 081113
SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Samples product data for doors.

PART 2 - PRODUCTS

2.1 FLUSH WOOD DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eggers Industries.
   2. Graham Wood Doors; ASSA ABLOY Group company.

2.2 DOOR CONSTRUCTION, GENERAL

A. Quality Standard: WDMA I.S.1-A.

B. WDMA I.S.1-A Performance Grade:
   1. Extra Heavy Duty.

C. Particleboard-Core Doors: Provide structural composite lumber cores instead of particleboard cores for doors with exit devices or protection plates.

2.3 FLUSH WOOD DOORS

A. Veneer-Faced Doors for Transparent Finish:
   1. Interior Solid-Core Doors: Custom grade, five-ply, particleboard or structural composite lumber cores.
      a. Faces: Grade A quarter-sliced white oak.
      c. Pair matching and set matching.

2.4 FABRICATION AND FINISHING

A. Factory-fit doors to suit frame-opening sizes indicated and to comply with clearances specified.

B. Factory-machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install doors to comply with manufacturer's written instructions and WDMA I.S.1-A, and as indicated.

B. Align and fit doors in frames with uniform clearances and bevels. Machine doors for hardware. Seal cut surfaces after fitting and machining.

C. Clearances: As follows unless otherwise indicated:
1. 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
2. 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering.
3. 1/4 inch (6.4 mm) from bottom of door to top of threshold.

END OF SECTION 081416
SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and color Samples.

1. For entrance doors, include hardware schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Design, engineer, fabricate, and install aluminum-framed storefronts to withstand structural loads indicated.

1. Limit deflection of framing members normal to wall plane to 1/175 of clear span or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.

2. Limit deflection of framing members parallel to glazing plane to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

B. Structural Testing: Systems tested according to ASTM E 330 at 150 percent of inward and outward wind-load design pressures do not evidence material failures, structural distress, deflection failures, or permanent deformation of main framing members exceeding 0.2 percent of clear span.

C. Air Infiltration: Limited to 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed framing and glass area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

D. Water Penetration: Systems do not evidence water leakage when tested according to ASTM E 331 at minimum differential pressure of 20 percent of positive wind-load design pressure but not less than 10 lbf/sq. ft. (480 Pa).

E. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than .57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) as determined according to NFRC 100.

2.2 ALUMINUM-FRAMED STOREFRONTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EFCO Corporation.

2. Kawneer North America, an Arconic company; basis of design products: Trifab 400 for interior framing and Trifab VersaGlaze 451 for exterior framing.

3. Oldcastle BuildingEnvelope™.

4. Trulite Glass & Aluminum Solutions, LLC.

5. YKK AP America Inc.

B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated; ASTM B 209 (ASTM B 209M) sheet; ASTM B 221 (ASTM B 221M) extrusions.

C. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally improved for exterior systems and nonthermal for interior systems.

D. Doors: 1-3/4-inch- (44.5-mm-) thick glazed doors with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods. Provide snap-on, extruded-aluminum glazing stops and preformed gaskets.
1. Door Design: Narrow stile; 2-1/8-inch (54-mm) nominal width.
2. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
3. Interior Doors: Provide BHMA A156.16 silencers, three on strike jamb of single-door frames and two on head of double-door frames.
4. Hardware: As specified in Section 087100 "Door Hardware."

E. Glazing: Comply with Section 088000 "Glazing."

F. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

G. Fasteners and Accessories: Compatible with adjacent materials, corrosion resistant, nonstaining, and nonbleeding. Use concealed fasteners except for application of door hardware.

H. Fabrication: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory-assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.

   1. Door Framing: Reinforce to support imposed loads. Factory-assemble door and frame units and factory-install hardware to greatest extent possible. Reinforce door and frame units for hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.

I. Aluminum Finish: Class I, clear anodic finish; complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Isolate metal surfaces in contact with incompatible materials, including wood, by painting contact surfaces with bituminous coating or primer or by applying sealant or tape recommended by manufacturer.

B. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install framing components true in alignment with established lines and grades to the following tolerances:

   1. Variation from Plane: Limit to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
   2. Alignment: For surfaces abutting in line, limit offset to 1/16 inch (1.5 mm). For surfaces meeting at corners, limit offset to 1/32 inch (0.8 mm).
   3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

E. Install doors without warp or rack. Adjust doors and hardware to provide tight fit at contact points and smooth operation.

END OF SECTION 084113
SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Hardware schedule and keying schedule.

PART 2 - PRODUCTS

2.1 HARDWARE

A. Hinges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cal-Royal Products, Inc.
   b. Ives; an Allegion brand.
   c. McKinney Products Company; an ASSA ABLOY Group company.
   d. PBB, Inc.
   e. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2. Steel hinges with stainless-steel pins for exterior.
3. Nonremovable hinge pins for exterior and public interior exposure.
4. Ball-bearing hinges for doors with closers and entry doors.
5. Three hinges for 1-3/4-inch- (45-mm-) thick doors 90 inches (2300 mm) or less in height; four hinges for doors more than 90 inches (2300 mm) in height.

B. Locksets and Latchsets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Best Access Systems; Stanley Security Solutions, Inc.
   b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
   c. SARGENT Manufacturing Company; ASSA ABLOY.
   d. Schlage; an Allegion brand.

2. BHMA A156.2, Series 4000, Grade 1 for bored locks and latches.
3. BHMA A156.3, Grade 1 for exit devices.
4. Lever handles on locksets and latchsets.
5. Provide trim on exit devices matching locksets.

C. Key locks to Owner's existing master-key system.

1. Cylinders with five-pin tumblers.
2. Provide cylinders for storefront doors and other locking doors that do not require other hardware.
3. Provide construction keying.

D. Closers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
   b. LCN; an Allegion brand.
   c. SARGENT Manufacturing Company; ASSA ABLOY.

2. Mount closers on interior side (room side) of door opening. Provide regular-arm, parallel-arm, or top-jamb-mounted closers as necessary.
3. Adjustable delayed opening (accessible to people with disabilities) feature on closers.
E. Manual Flush Bolts:
   1. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
      b. Allegion plc.
      c. Trimco.
   3. Manual-Extension Flush Bolts: Grade 1, fabricated from extruded brass or aluminum, with 12-inch (305-mm) rod actuated by flat lever.
      a. Strike: Matching.
   4. Top-Bolt Extension Rod Length: As required to locate operating mechanism at not more than 72 inches (1829 mm) above the finished floor at all times.

F. Exit Devices:
   1. Exit Devices and Auxiliary Items: BHMA A156.3.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
         2) Allegion plc.
         3) Corbin Russwin, Inc.; an ASSA ABLOY Group company.
         4) DORMA USA, Inc.
         5) SARGENT Manufacturing Company; ASSA ABLOY.
         6) Stanley Commercial Hardware; a division of Stanley Security Solutions.
         7) Yale Security Inc; an ASSA ABLOY Group company.
   2. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
      a. Type: 1, rim.
      b. Actuating Bar: Narrow-stile push pad.
      a. Type: 2.
      b. Actuating Bar: Narrow-stile push pad.
      d. Configuration: Top rod.

G. Provide wall stops or floor stops for doors without closers.

H. Metal Protective Trim Units:
   1. 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.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hager Companies.
      b. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
      c. Trimco.
   3. Kick Plates: 12 inches (305 mm) high by door width with allowance for frame stops.

I. Door Gasketing:
   1. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) National Guard Products, Inc.
         2) Pemko Manufacturing Co.
         3) Zero International, Inc.
   2. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:
      a. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
      b. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.
   3. Adhesive-Backed Perimeter Gasketing: Neoprene bulb gasket material applied to frame rabbet with self-adhesive.
   4. Door Sweeps: Nylon brush gasket material held in place by flat housing or flange; surface mounted to face of door with screws.
      a. Housing or Flange Material: Aluminum.
J. Hardware Finishes:
   2. Locksets, Latchsets, and Exit Devices: Satin chrome plated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount hardware in locations required to comply with governing regulations and according to SDI A250.8 and DHI WDHS.3.
   
B. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet.

C. Deliver keys to Owner.

3.2 HARDWARE SCHEDULE

A. Hardware Set No. 1: Existing Exterior Doors (2) Pair of Metal Doors
   1. (2) Closers.
   2. (2) Vertical Rod Exit Devices with trim.
   3. (1) Set Weather Seals.
   4. (1) Cylinder lockset.
   
B. Hardware Set No. 2: Door 117
   1. (6) Hinges
   2. (2) Closers
   3. (2) Rim Exit Devices
   4. (2) Lever Locksets
   5. (4) Silencers
   6. (2) Kickplates
   
C. Hardware Set No. 3: Door 122
   1. (6) Hinges
   2. (1) Storeroom Lockset
   3. (1) Dummy Handle
   4. (1) Set of Flush Bolts
   5. (4) Mutes
   
D. Hardware Set No. 4: Door 116
   1. (3) Hinges
   2. (1) Storeroom Lockset
   3. (3) Silencers
   4. (1) Kickplate
   
E. Hardware Set No. 5: New Pair of Storefront Doors
   1. (2) Cylinders
   
F. Hardware Set No. 6: Door 126
   1. (1) Cylinder
   
G. Hardware Set No. 7: Existing Wood Door
   1. (1) Office Lockset

END OF SECTION 087100
SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples for insulated glazing panel finish selections.

PART 2 - PRODUCTS

2.1 GLASS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Glazing Manual."

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

C. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

2.2 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C 1048, Kind FT; Type I; Quality-Q3.

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

2.3 GLAZING SEALANTS

A. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bostik, Inc.
   b. GE Construction Sealants; Momentive Performance Materials Inc.
   c. The Dow Chemical Company.
   d. Tremco Incorporated.

2.4 WINDOW FILM

A. Optically opaque polyester film for decorative applications, with an abrasion resistant coating on one side and a mounting adhesive on the other.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. 3M.
   b. Johnson Laminating & Coating, Inc.
   c. Solyx.
2. Uniformity: No noticeable visual defects, such as pinholes, streaks, thin spots, scratches, or banding in accordance with the IWFA visual acceptance standard, after installation.

3. Variation in Solar Specifications across Width: +/- 3% average at any portion of the length.

4. Thickness: Nominal 1.5 mils (38 microns) with no evidence of coating voids, after the removal of the release liner.

5. Identification: Labeled in accordance with manufacturer's specifications.

6. Capacities in accordance with ASTM E903:
   a. Film Appearance: Opaque, color as selected by Architect from manufacturer's full range of colors.
   b. Visible Light Transmission: 0%.
   c. Solar Energy Rejected/Heat Reduction: 70%.
   d. Visible Light Reflectance (Exterior): 7%.
   e. Visible Light Reflectance (Interior): 6%.
   f. Shading Coefficient: 0.36.
   g. Solar Heat Gain Coefficient: 0.30.
   h. U Factor: NFRC; 1.10.
   i. Solar Energy Absorption: 94%.
   j. Solar Transmission: 0%.
   k. Solar Reflectance: 6%.
   l. UV Rejection: 100%.
   m. Glare Reduction: 100%.

7. Install film on the #4 glass surface.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are contained in GANA's "Glazing Manual."

B. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

C. Remove nonpermanent labels, and clean surfaces immediately after installation.

3.2 MONOLITHIC-GLASS TYPES

A. Glass Type: Clear fully tempered float glass.
   1. Thickness: 6 mm.
   2. Safety glazing required.

3.3 INSULATING-GLASS TYPES

A. Glass Type: Low-E-coated, clear insulating glass.
   1. Overall Unit Thickness: 1 inch (25 mm).
   2. Thickness of Each Glass Lite: 6 mm.
   3. Outdoor Lite: Fully tempered float glass.
   4. Interspace Content: Air.
   5. Indoor Lite: Fully tempered float glass.
   9. Safety glazing required.

END OF SECTION 088000
SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS
   A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 METAL FRAMING AND SUPPORTS
   A. Steel Framing Members, General: ASTM C 754.
      1. Steel Sheet Components: ASTM C 645. Thickness specified is minimum uncoated base-metal thickness.
   B. Framing Systems:
      1. Studs and Runners: In depth indicated and 0.0296 inch (20 gage) thick unless otherwise indicated.

2.2 ACCESSORIES
   A. General: Comply with referenced installation standards.
      1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install steel framing to comply with ASTM C 754.*
      1. Gypsum Board Assemblies: Also comply with ASTM C 840.
   B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

END OF SECTION 092216
SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product data.

PART 2 - PRODUCTS

2.1 PANEL PRODUCTS

A. Provide in maximum lengths available to minimize end-to-end butt joints.

B. Interior Gypsum Board: ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum.
      b. CertainTeed Corporation.
      c. Georgia-Pacific Gypsum LLC.
      d. USG Corporation.

2.2 ACCESSORIES

A. Trim Accessories: ASTM C 1047, formed from galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet. For exterior trim, use accessories formed from hot-dip galvanized-steel sheet, plastic, or rolled zinc.
   1. Provide cornerbead at outside corners unless otherwise indicated.
   2. Provide LC-bead (J-bead) at exposed panel edges.
   3. Provide control joints where indicated.

B. Joint-Treatment Materials: ASTM C 475/C 475M.
   1. Joint Tape: Paper unless otherwise recommended by panel manufacturer.
   2. Joint Compounds: Setting-type taping compound and drying-type, ready-mixed, compounds for topping.

C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.


E. Sound-Attenuation Blankets: ASTM C 665, Type I (unfaced).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gypsum board to comply with ASTM C 840.
   1. Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustical sealant.
B. Finishing Gypsum Board: ASTM C 840.

1. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.

2. Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.

END OF SECTION 092900
SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Standard: Acoustical panel ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

2.2 ACOUSTICAL PANELS CT-A

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. USG Corporation.

B. Classification: As follows, per ASTM E 1264:

1. Type and Form: Type III, Form 1.
3. LRC: Not less than 0.85.
4. NRC: Not less than 0.75.
5. CAC: Not less than 35.
6. Surface-Burning Characteristics: Class A.

C. Color: White.

D. Edge Detail: Square.

E. Thickness: 7/8 inch (22 mm).

F. Modular Size: 24 by 24 inches (610 by 610 mm).

2.3 ACOUSTICAL PANELS CT-B

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. USG Corporation.

B. Classification: As follows, per ASTM E 1264:

1. Type and Form: Type III, Form 2.
2. Pattern: CE (perforated, small holes and lightly textured)
3. LRC: Not less than 0.85.
4. NRC: Not less than 0.55.
5. CAC: Not less than 30.
6. Surface-Burning Characteristics: Class A.

C. Color: White.

D. Edge Detail: Square.

E. Thickness: 7/8 inch (22 mm).

F. Modular Size: 24 by 24 inches (610 by 610 mm)

2.4 CEILING SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corporation.
   3. USG Corporation.

B. Ceiling Suspension System: Wide-face, direct-hung system; ASTM C 635, intermediate-duty structural classification.
   1. Face Design: Flat, flush.
   2. Face Finish: Painted white.

C. Attachment Devices: Sized for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.

D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   1. Size: Provide yield strength at least 3 times the hanger design load (ASTM C 635, Table 1, Direct Hung), but not less than 0.135-inch- (3.5-mm-) diameter wire.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install acoustical 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. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

C. Arrange directionally patterned acoustical units with pattern parallel to long axis of space.

END OF SECTION 095113
PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product data and Samples.

B. Extra Materials: Deliver to Owner at least 10 linear feet (3 linear m) of each type and color of resilient wall base installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Thermoset Rubber Base: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Flexco.

   b. Johnsonite; a Tarkett company.

   c. Roppe Corporation, USA.

B. Style: Cove (base with toe).

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: coils in manufacturer’s standard lengths.

F. Outside Corners: preformed.

G. Inside Corners: Job formed or preformed.

2.2 RESILIENT MOLDING ACCESSORY

A. Vinyl Molding Accessories.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Flexco.

   b. Johnsonite; a Tarkett company.

   c. Roppe Corporation, USA.

B. Description: Stair-tread nosing and reducer strip for resilient flooring.

2.3 INSTALLATION ACCESSORIES

A. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare horizontal surfaces according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

B. Adhesively install resilient wall base and accessories.

C. Install wall base in maximum lengths possible. Apply to walls, columns, pilasters, casework, and other permanent fixtures in rooms or areas where base is required.

D. Install stair-tread-nose filler to nosing substrates that do not conform to tread contours.

E. Install reducer strips at edges of floor coverings that would otherwise be exposed.

END OF SECTION 096513
SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product data and Samples.

B. Extra Materials: Deliver to Owner one box of each type and color of resilient floor tile installed.

PART 2 - PRODUCTS

2.1 SOLID VINYL TILE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc.
   2. Johnsonite; a Tarkett company.
   3. Mannington Mills, Inc.
   4. Shaw Contract Group; a Berkshire Hathaway company.

B. Tile Standard: ASTM F 1700; Class III, printed film vinyl tile; Type B, embossed surface.

C. Thickness: 0.100 inch (2.5 mm).

D. Size: 6 by 36 inches (152.4 by 914 mm).

E. Basis of Design Product: Mannington Mills, Inc.; Stride; basis of design product is based upon the following properties:
   1. Design of tile pattern (No wood grain patterns).
   2. Color options available in both neutrals and purple accent color to match university’s color scheme.
   3. Plank size (No plank smaller than 5” wide).
   4. Additional products may be submitted by additional manufacturers as listed above for Prior Approval by Architect during the time of bidding.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement- or blended-hydraulic-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare concrete substrates according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

B. Lay out tiles so tile widths at opposite edges of room are equal and are at least one-half of a tile.

C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged. Lay tiles in patterns indicated.

END OF SECTION 096519
SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:
   1. Product Data: Include printout of MPI's "MPI Approved Products List" with product highlighted.
   2. Samples.

B. Mockups: Full-coat finish Sample of each type of coating, color, and substrate, applied where directed.

C. Extra Materials: Deliver to Owner 1 gal. (3.8 L) of each color and type of finish-coat paint used on Project, in containers, properly labeled and sealed.

PART 2 - PRODUCTS

2.1 PAINT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Benjamin Moore & Co.
   2. PPG Paints.

B. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."
   1. Primer Sealer, Latex: MPI #50.
   2. Primer, Alkali Resistant, Water Based: MPI #3.
   3. Primer, Quick Dry Alkyd, for Metal: MPI #76.
   5. Latex, High-Performance Architectural, Semigloss (Gloss Level 5): MPI #141.
   6. W.B. Dry Fall (Gloss Level 1): MPI #133.

C. Material Compatibility: Provide materials that are compatible with one another and with substrates.
   1. 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.

D. Colors: As selected.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.

C. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

3.2 APPLICATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
B. Paint exposed surfaces new and existing unless otherwise indicated.

1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.
2. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint the back side of access panels.
5. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.

C. Apply paints according to manufacturer's written instructions.

1. Use brushes only where the use of other applicators is not practical.
2. Use rollers for finish coat on interior walls and ceilings.

D. 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.

1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

3.3 INTERIOR PAINT APPLICATION SCHEDULE

A. Clay Masonry:
1. Gloss Level 3 High-Performance Architectural Latex: Two coats over alkali-resistant, water-based primer: MPI INT 4.1L.

B. Steel:
1. Semigloss High-Performance Architectural Latex: Two coats over quick-drying alkyd primer: MPI INT 5.1R.
2. Flat latex dry fall for overheading paint above as indicated on drawings: Two coats, quick-drying alkyd primer: MPI INT 5.1.C.

C. Wood: Including doors.
1. Gloss Level 2 High-Performance Architectural Latex: Two coats over latex primer for wood: MPI INT 6.3A.

D. Gypsum Board:
1. Eg-Shel High-Performance Architectural Latex: Two coats over latex primer/sealer: MPI INT 9.2B.

END OF SECTION 099123
SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:
   1. Product Data: Include printout of MPI's "MPI Approved Products List" with product highlighted.
   2. Samples.

B. Mockups: Full-coat finish Sample of each type of coating, color, and substrate, applied where directed.

C. Extra Materials: Deliver to Owner 1 quart (0.9 L) of each color and type of stain and transparent finish used on Project, in containers, properly labeled and sealed.

PART 2 - PRODUCTS

2.1 STAINED AND TRANSPARENT FINISHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Benjamin Moore & Co.
   2. PPG Paints.

B. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."
   1. Varnish, Interior, Polyurethane, Oil Modified, Satin (Gloss Level 4): MPI #57.
   2. Stain, Interior, water based, semi-transparent MPI #186.

C. Material Compatibility: Provide materials that are compatible with one another and with substrates.
   1. 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.

D. Colors: As selected.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, lighting fixtures, and similar items that are not to be finished. Mask items that cannot be removed. Reinstall items in each area after finishing is complete.

C. Clean and prepare surfaces in an area before beginning finishing in that area. Schedule finishing so cleaning operations will not damage newly finished surfaces.

3.2 APPLICATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Finish exposed surfaces new and existing, unless otherwise indicated.

C. Apply stains and transparent finishes according to manufacturer's written instructions.
D. Apply stains and transparent finishes to produce surface films without color irregularity, cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other imperfections. Use multiple coats to produce a smooth surface film of even luster.

3.3 INTERIOR STAIN AND CLEAR FINISH APPLICATION SCHEDULE

A. Wood substrates, nontraffic surfaces, including doors.
   1. Satin Oil-Modified Polyurethane Varnish over Stain: Two coats over stain: MPI INT 6.3 EE.
SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and Samples.

PART 2 - PRODUCTS

2.1 SIGNS, GENERAL


2.2 PANEL SIGNS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. APCO Graphics, Inc.
2. ASI Sign Systems, Inc.
3. Best Sign Systems, Inc.
4. Inpro Corporation.

B. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to phenolic backing sheet to produce composite sheet.
   1. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
   2. Surface-Applied Graphics: Manufacturer's standard applied material to comply with accessibility requirements for tactile signage, including raised characters and Braille.
   3. Color(s): As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate signs where indicated or directed by Architect. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.

B. Wall-Mounted Signs:

1. Two-Face Tape: Mount signs to smooth, nonporous surfaces, other than vinyl.
3. Magnetic Tape: Mount signs to smooth, nonporous surfaces.
4. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
5. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes.

C. Signage Schedule:

<table>
<thead>
<tr>
<th>Number of Signs</th>
<th>Signage Text</th>
<th>Room Number for Signage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Multipurpose</td>
<td>XXXX</td>
</tr>
<tr>
<td>1</td>
<td>Janitor</td>
<td>XXXX</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1</td>
<td>Toilet</td>
<td>XXXX</td>
</tr>
<tr>
<td>5</td>
<td>Exit</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Workroom</td>
<td>XXXX</td>
</tr>
<tr>
<td>1</td>
<td>E Sports</td>
<td>XXXX</td>
</tr>
<tr>
<td>1</td>
<td>Office</td>
<td>XXXX</td>
</tr>
<tr>
<td>1</td>
<td>Office</td>
<td>XXXX</td>
</tr>
</tbody>
</table>

END OF SECTION 101400
SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 FIRE-PROTECTION CABINETS

A. Fire-Protection Cabinets: Enameled-steel, surface-mounted cabinets for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. JL Industries, Inc.; a division of the Activar Construction Products Group.
   b. Larsens Manufacturing Company.
   c. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Steel sheet.

1. Trim Style: Square trim.
2. Trim Material: Steel.

D. Door Material: Aluminum.

1. Door Style: Vertical duo.
2. Door Glazing: Acrylic.

E. Accessories: Identification lettering.

F. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
   a. Exterior of cabinet except for those surfaces indicated to receive another finish.
   b. Interior of cabinet.

3. Steel: Baked enamel or powder coat.

2.2 FIRE EXTINGUISHERS

A. Portable Fire Extinguishers: NFPA 10, listed and labeled for the type, rating, and classification of extinguisher.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amerex Corporation.
   b. JL Industries, Inc.; a division of the Activar Construction Products Group.
   c. Kidde Residential and Commercial Division.
   d. Larsens Manufacturing Company.
   e. Potter Roemer LLC; a Division of Morris Group International.

2. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, in enameled-steel container.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cabinets at heights acceptable to authorities having jurisdiction.

B. Identification: Apply vinyl lettering to cabinets at locations indicated.

END OF SECTION 104400
SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Shop Drawings and Samples.

B. Installer Qualifications: Fabricator of products.

C. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is completed, and HVAC system is operating.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS


B. Plastic-Laminate Countertops: Custom grade.

1. Laminate Grade: HGS for flat countertops, HGP for post-formed countertops.
2. Grain Direction: Parallel to cabinet fronts.
3. Edge Treatment: Same as laminate cladding on horizontal surfaces.
4. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   a. As selected by Architect from manufacturer's full range of standard and premium colors in the following categories:
      1) Solid colors, matte finish.
      2) Wood grains, matte finish with grain running parallel to length of countertop.
      3) Patterns, matte finish.
5. Core Thickness: ¾ inch (19 mm)
   a. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of core material laminated top.

2.2 MATERIALS

A. Wood Moisture Content: 5 to 10 percent.

B. Softwood Plywood: DOC PS 1.

C. High-Pressure Decorative Laminate: NEMA LD 3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Formica Corporation.
   c. Wilsonart LLC.

D. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: "SG series" by Doug Mockett & Company, Inc.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install countertops to comply with referenced quality standard for grade specified.

B. Install countertops 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 countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Seal space between countertop and wall.

END OF SECTION 123623.13
SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product data, Shop Drawings, and material Samples.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

A. Countertops: 1/2-inch- (12.7-mm-) thick, solid-surface material on 3/4-inch- (19-mm-) thick plywood.
   1. Edges: Built up with solid-surface material.
   2. Front: Straight, slightly eased at top.
   3. Use 1/4-inch- (6.4-mm-) thick for vertical waterfall surfaces.

B. Solid-Surface Material: Homogeneous, filled plastic resin complying with ICPA SS-1.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dupont Corian.
      b. Formica Corporation.
      c. Meganite Inc.
      d. Samsung Chemical USA, Inc.
      e. Wilsonart LLC.

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install countertops according to manufacturer's written directions. Fasten to substrates with adhesive. Align adjacent surfaces. Seal seams and perimeter with mildew-resistant silicone sealant.

B. Install level and plumb to a tolerance of 1/8 inch in 8 feet (3.2 mm in 2.4 m).

C. Joints: Fabricate countertops without joints.

END OF SECTION 123661.16
1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 21, 21 and 23 Specification sections, apply to work specified in this Section.

B. NFPA 101, NFPA 13, NFPA 24, NFPA 1, International Building Code, FM Data Sheets and any other related document referenced by these standards or this specification. NFPA standards and this specification are not intended to serve as complete manuals for sprinkler system design and installation and they cannot be expected to eliminate the need for experience and consultation with the authorities having jurisdiction. All applicable NFPA standards, building codes and their appendices, comments and Formal interpretations shall be a requirement of this specification. The word “should” noted in the appendices and commentaries of all NFPA standards shall be interpreted as shall by the requirements of this specification.

1.2 DESCRIPTION OF WORK

A. Extent of fire protection systems work is indicated on drawings and schedules, the requirements of this Section, and the related documents indicated above.

B. Applications of fire protection systems include the following:

1. Design and installation of a complete wet pipe automatic fire protection sprinkler system throughout heated portions of the building. System shall be hydraulically designed for Light hazard and/or Ordinary hazard occupancy in accordance with NFPA 13. All mechanical and storage areas shall be considered Ordinary/Extra Hazard in accordance with NFPA 13.

2. Sprinklers shall be installed throughout the premises, including attics, concealed spaces, spaces with exposed combustibles, exterior roofs and/or canopies. Sprinklers may be omitted only from areas specifically listed in NFPA 13 and/or NFPA 101.

3. Provide a dry pipe system for any portion of the fire protection system piping located in areas that may be subject to freezing temperatures. Systems for these areas shall be designed in strict accordance with NFPA 13, other applicable codes, regulations and recommendations of the State Fire Marshal's office, and any local ordinances.

4. Antifreeze Systems shall not be used.

5. Locate all sprinklers in finished areas in the center of the ceiling tiles.

6. Where dry pipe systems are used, calculations shall be provided indicating delivery times in accordance with NFPA 13: 7.2.3.6. Calculation program and method shall be listed by a nationally recognized testing laboratory.

7. Contractor shall perform an onsite survey to field verify all dimensions, obstructions to piping and sprinkler discharge, and to properly coordinate sprinkler system installation with other trades.
8. Contractor shall be responsible for obtaining water supply information. The Contractor shall use information from tests performed during periods of peak usage at or near the point of connection to the water supply. Contractor shall provide documentation verifying test have been taken or witnessed by local authorities. Water supply information shall be clearly indicated on a site plan, drawn to an indicated scale.

9. Include a minimum of 10-psi pressure cushion or safety factor in the hydraulic calculations.

C. Trenching and backfill required in conjunction with exterior fire protection piping is specified in applicable Divisions 22 Sections, and is included as work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of fire protection piping systems products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least one full-time employed NICET certified "Engineering Technician" and a minimum of 5 years of successful installation experience on projects with fire protection piping work similar to that required for this project.

1. Contractor shall be familiar with doing work in the State of Louisiana, and be fully aware of the requirements of the Fire Marshal’s Office.


D. FM Compliance: Comply with Factory Mutual "Approval Guide" and/or “Data Sheets.”

1. FM Labels: Provide sprinkler products bearing FM approval labels.
2. Comply with FM Data Sheets where required by owners insurance company or these specifications.

E. UL Labels: Provide fire sprinkler piping products which have been approved and labeled by Underwriters Laboratories.

F. Insurance Company Requirements: Comply with all requirements of Owner's insurance company.

1. It shall be the contractor’s responsibility to verify owner’s insurance company and/or any special requirements needed for compliance.
2. Name and address of Owner's insurance company shall be clearly legible on all submittals.

G. Local Fire Department/Marshal Regulations: Comply with governing regulations pertaining to fire sprinkler piping.
1. It shall be the responsibility of the contractor to obtain approved final working drawings from the fire Marshal’s office. The drawings, these specifications, and the fire marshal’s approval represent a minimum requirement for compliance.

1.4 SUBMITTALS

A. Product Data: Submit hydraulic calculations and manufacturer's data for fire protection systems, materials, and products. All submittals shall be neatly arranged in Notebook / Binder form, complete with table of contents and/or dividers for each section such as pipe, hangers, sprinklers, etc. When submitting product data containing more than one model, size, or style of the same or different product, it shall be clearly indicated which product is being submitted. All items not clearly indicated shall be rejected.

B. Shop Drawings: Submit working shop drawings in accordance with the requirements of NFPA 13, other applicable standards and this specification. Shop drawings shall include all necessary changes required by an onsite survey. Contractor shall make all corrections required by Architect, Fire Marshal, and any other Authority Having Jurisdiction and resubmit as required.

C. Hydraulic Calculations: Systems requiring hydraulic calculations shall be designed in strict accordance with NFPA 13, these specifications and the following:

1. Hydraulic reference points shall be provided at each fitting (tee) where a flow split occurs.
2. When calculating portions of existing systems the friction loss coefficient (C-factor) shall be reduced by 20 percent.
3. A detailed summary of the design approach (criteria), including but not limited to, Occupancy Classification, Design Density, Area Modifications, Roof Slopes, and other information to aide the reviewer in reaching the intent of the submitted design.

D. Plans not containing the requirements for a standard submittal shall be rejected without further review. Plans shall include all possible obstructions to the sprinkler discharge located at the ceiling.

E. As Built Drawings: Provide an electronic file copy of the final installed and approved set of fire protection shop drawings. Final drawings shall incorporate all modifications required during installation and shall be set up on sheets of the same size and uniformity of the construction documents, using the Architect's title border.

1.5 REQUIREMENTS FOR A STANDARD SUBMITTAL

A. All sprinkler system shop drawing submittals shall be drawn to an indicated scale, on sheets of uniform size, with a plan of each floor, and include all applicable items listed in NFPA 13 for working drawings, including the following:

1. Full height cross section, including dimensions, sprinkler piping locations, structural member information and methods of protecting nonmetallic piping. Enough sections shall be included to make all construction features and conditions clear to the plan reviewer.
2. Occupancy classification of each area or room.
3. Location and rating of fire walls.
4. Building height in feet.
5. Elevation of each floor above grade level.
6. Any questionable small enclosures, in which no sprinklers are to be installed, shall indicate reason for sprinkler omission based on NFPA code.
7. Waterflow test information. Drawings shall indicate the date and time of the test, the name of the party that conducted the test, the location of hydrants where the flow was taken and where static and residual pressure readings were recorded, the size and configuration of mains supplying the hydrants, the size and number of open hydrant butts, and the results of the test.
8. Building features such as combustible concealed spaces, floor openings, areas subject to freezing.
9. Any combustible concealed space, in which it is intended to omit sprinklers, shall be clearly indicated, with reason for omission based on NFPA codes.
10. For hydraulically designed systems, the hydraulic area shall be clearly outlined so as to clearly indicate to the reviewer the size and shape of the area calculated.
11. Roof heights and slopes shall be clearly indicated on drawings.
12. The information required in Section 1.4 of this specification.

B. In order to expedite the project review, a key plan for multi-sheet plans shall be provided. When building is subdivided to fit sheet, the key plan should indicate the area of the building shown on each respective sheet. Appropriate match lines should be indicated.

C. When adding to an existing system, the particular area of the building where the work is performed shall be identified and the project title shall reflect that area of the building.

D. In modification to a system in multi-system building, the particular system being worked on shall be identified.

E. For all storage rooms and facilities, the following shall be identified:
   1. The type of construction, area, and height of buildings (this includes office warehouse facilities, department stores, etc.)
   2. Identify commodity and how it shall be stored (encapsulated on pallets, in racks, the height of storage, the aisle widths, etc.)
   3. Hazard classification based on NFPA 13 or other NFPA standard.

F. Hydraulic data sheet shall be filled out completely.

G. Nameplate, in accordance with NFPA 13:7-1.2 shall be provided on risers, and each area controlled by the particular valve shall be indicated.

H. Insurance Company Approval: Obtain approval of Owner's insurance company prior to submitting to the Architect.

I. Certificate of Installation: Submit certificate upon completion of fire protection piping work, which indicates that work has been tested in accordance with ANSI/NFPA 13 and ANSI/NFPA 24, and also that system is operational, complete, and has no defects.

PART 2 - PRODUCTS
2.1 FIRE PROTECTION PIPING MATERIALS AND PRODUCTS:

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in fire protection piping systems. Where more than one type of material or product is indicated, selection is Installer's option.

1. When system pressures exceed 175 psi, all piping materials, fittings, valves, etc. shall be extra heavy pattern.

2.2 BASIC PIPE, TUBE AND FITTINGS

A. General: Provide pipe, tube, and fittings complying with Divisions 22 Section, "Basic Mechanical Materials and Methods," in accordance with NFPA 13, and NFPA 24, with the following exception:

1. Interior Piping: All piping shall be Schedule 40 black steel (ANSI/ASTM A53).
2. Underground Exterior Piping: All piping shall be Polyvinyl Chloride (AWWA C900) class 200, Blue Brute or equal. Piping shall be UL Listed for fire protection use. Pipe passing thru slab shall be ductile iron AWWA C104.
3. Cast Iron Fittings: Standard weight cast iron fittings 2 inches and smaller shall be permitted where pressures do not exceed 275 psi.
4. Malleable Iron Fittings: Standard weight malleable iron fittings 3 inches and smaller shall be permitted where pressures do not exceed 300 psi.
5. Screwed unions shall not be used on pipe larger than 1 inch.
6. Flexible Stainless-Steel Hose Systems to connect sprinklers to branchlines shall not be used.

2.3 BASIC HANGERS AND SUPPORTS

A. General: Provide hangers and supports complying with Divisions 22 Section, "Hangers and Supports" in accordance with NFPA 13.

2.4 GENERAL DUTY VALVES

A. General: All valves controlling flow of water to sprinklers shall be listed and shall be rated for the maximum working pressure to which they are exposed but shall not be less than indicated below. Check valves installed in buildings more than 30 ft. in height shall be of the anti-water hammer type.

1. Gate Valves - 2 Inch and Smaller: Body and bonnet of cast bronze, 175 pound cold water working pressure - non-shock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open.
2. Gate Valves - 2-1/2 Inch and Larger: Iron body; bronze mounted, 175-pound cold water working pressure - non-shock. Valves shall have solid taper wedge; outside screw and
yoke, rising stem; flanged bonnet, with body and bonnet conforming to ASTM A 126, Class B; replaceable bronze wedge facing rings; flanged ends; and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open.

3. Swing Check Valves, NPS 2 (DN50) and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.

4. Swing Check Valves, NPS 2-1/2 (DN65) and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.

5. Butterfly valves shall not be used, except where indicated on drawings.

2.5 SPECIAL VALVES

A. General: Provide valves, UL/FM approved, in accordance with the following listing. Provide sizes and types which mate and match piping and equipment connections. All valves shall be rated to the maximum pressure to which they are exposed, but not less than the pressure indicated below.

1. Alarm Check Valve: Provide UL/FM approved cast-iron water flow alarm check valve, 175 psi working pressure for wet-pipe systems. Alarm valves shall be installed in heated areas, maintained at or above 40 deg. F. Additional heat shall be provided when not supplied by the building heating system. Include alarm switch with contacts as required by fire alarm system. Provide cast iron retarding chamber and drip funnel.

2. In buildings or areas subject to freezing, provide a UL/FM approved dry-pipe valve, complete with necessary trim and air maintenance device. Dry valves shall be installed in heated areas, maintained at or above 40 deg. F. Additional heat shall be provided when not supplied by the building heating system.

3. Provide alarm switches with contacts as required by fire alarm system.

2.6 FIRE PROTECTION SPECIALTIES

A. General: Provide fire protection specialties, UL/FM approved, in accordance with the following listing. Provide sizes and types which mate and match piping and equipment connections. All system components shall be rated for the maximum working pressure to which they are exposed, but not less than 175 psi.

B. Water Flow Indicators: Provide vane type water flow detectors or pressure-activated switches. (Vane-type water flow detectors shall not be used on deluge, dry pipe, or pre-action systems.) When using vane-type detectors a pressure drop of 3 psi shall be included for sizes 4 in. and smaller. Sizes 6 in. and larger shall include a pressure drop of 1 psi.

C. Water-Motor Gongs: Provide 10 inches weatherproof, red enameled finish, water-motor gongs.

D. Air Compressor: Provide air compressor for dry pipe systems, capable of restoring normal air pressure in the system within 30 minutes.

E. Supervisory Switches: Provide products recommended by manufacturer for use in service required. Provide contact arrangement as required by fire alarm system.
F. Automatic Sprinklers: Provide automatic sprinklers of the type required by NFPA 13. Provide Quick Response fusible link/glass bulb type sprinklers of the ordinary temperature rating (135 to 170°F) unless otherwise indicated or where ceiling temperatures exceed 100°F. Provide dry type sprinklers in dry pipe systems and/or areas subject to freezing. Where ceiling temperatures exceed 100°F, the temperature rating of sprinklers shall comply with NFPA 13, for the appropriate hazard and/or ceiling temperature. Where system pressures exceed 175 psi, high pressure sprinklers shall be used.

1. Finish: Factory painted white, in finished areas. Cast brass in unfinished areas. Except that all sprinklers exposed to outside weather conditions, humid, or corrosive environments, shall have a corrosive resistant coating.

G. Escutcheons: Provide recessed type escutcheon for each pendent head, finish to match sprinkler. Escutcheon plates used with recessed or flush-type sprinklers shall be part of a listed assembly.

H. Sprinkler Cabinet and Wrench: Furnish steel, baked red enameled, sprinkler box with capacity to store the extra stock of sprinklers and wrench.

I. Small-orifice sprinklers shall be installed in wet systems only.

2.7 BACKFLOW PREVENTERS

A. General: Provide backflow prevention device in accordance with AWWA, State, and/or local requirements. A means shall be provided downstream of all backflow prevention devices to perform a full flow test at the sprinkler system demand.

B. 2-1/2 Inch NPS (DN65) and Larger: Bronze, cast-iron, steel, or stainless steel body with flanged ends.

C. Interior Lining: AWWA C550, epoxy coating for backflow preventers with cast-iron or steel body.

D. Interior Components: Corrosion-resistant materials.

E. Strainer on inlet if strainer is indicated.

F. Reduced-Pressure-Principle Backflow Preventer: Where chemicals are introduced into the fire protection system piping, either directly or indirectly, by the local fire department. A reduced pressure type BFP shall be provided in accordance with the following: ASSE 1013, with OS&Y gate valves on inlet and outlet. Include test cocks and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves for continuous-pressure application.

2.8 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections: UL 405; cast-brass body with brass, escutcheon plate; brass, lugged caps with gaskets and brass chains; and brass, lugged swivel connections. Include inlets
with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking "AUTO SPKR." Fire Department Connections shall be installed in locations easily accessible to the Fire Department and shall not be less than 24” or more than 48” above the level of the adjacent grade. Final location shall be approved by the local fire department. Provide a signed written statement from the local fire department indicating that the FDC location, outlet diameters, and hose threads as indicated on the drawing submittal meet the requirements of their office. A listed check valve with an approved automatic drip shall be installed in each Fire Department Connection.

1. Type: Two-way Siamese or flush type.
2. Escutcheon Plate: Rectangular or Round, as required.
3. Finish: Cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE, TUBE AND FITTINGS:

A. General: Install pipe, tube and fittings in accordance with Divisions 22 section "Basic Mechanical Materials and Methods", and NFPA 13. When wet pipe systems are installed, piping shall not be located in areas subject to freezing. Dry pipe, pre-action, antifreeze systems, or heat shall be supplied, when alternate methods of routing the piping are not possible.

B. Fire Sprinkler Piping Systems:

1. General: Comply with requirements of ANSI/NFPA 13 and 24 for installation of fire sprinkler piping materials. Install fire sprinkler piping products where indicated, in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that fire sprinkler piping complies with requirements and serves intended purposes. Conceal all piping in finished areas.
2. Coordinate with other work, including plumbing piping, as necessary to interface components of fire sprinkler piping properly with other work.
3. Provide all pipe and fittings necessary to locate sprinklers in the middle of the ceiling tiles.
4. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Bushings will not be permitted.
5. Install sprinkler piping with drains for complete system drainage. Install auxiliary drains at each location where a change in piping direction prevents drainage of system piping through the main drain valve. Install drains in accordance with NFPA 13.
6. Install readily removable fittings at the end of all cross mains. All cross mains shall terminate in 1¼” or larger pipe.
7. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
8. Install an indicating control valve in the connection to retarding chamber, pressure type contactors or water motor operated alarm devices. Valve shall be supervised in accordance with NFPA 13.
9. Steel pipe shall not be used in Fire Department Connections, except as permitted by NFPA 13.
3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with Divisions 22 section "Hangers and Supports" and NFPA 13, except that all armovers and return bends more than 6" in length shall be supported by a hanger.

1. All armovers supplying drops longer than 24” shall be supported by a hanger.
2. Drops longer than 10 ft. shall be restrained to prevent turning or excessive vertical and lateral movement using methods in accordance with NFPA 13.
3. Sprig-ups 4ft. or longer shall be restrained against lateral movement in accordance with NFPA 13.

3.3 COORDINATION OF TRADES

A. Piping offsets, fittings, and any other accessories required shall be provided as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping, platforms, soffits and other construction features, when such features or equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

3.4 INSTALLATION OF FIRE PROTECTION SPECIALTIES

A. General: Install fire protection specialties as required and in accordance with ANSI/NFPA 13.

1. Mount supervisory switches on each sectional and/or control valve.

3.5 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to city, plumbing and health department authorities having jurisdiction.

1. Final location and positioning of backflow preventer shall be approved by the local authorities prior to installation.
2. When installed in the vertical position, backflow preventer shall be UL listed for vertical installation.

B. When backflow preventers are installed outside, they shall be installed above ground, in a heated insulated enclosure. The enclosure shall have a heat source capable of maintaining 40 deg. F inside the enclosure when subjected to -30 deg F outside air temperatures. The enclosure shall be mounted on a concrete pad and shall be capable of draining. The depth of water within the enclosure shall not exceed 6” during full flow of the backflow preventer relief discharge, nor shall the depth of water exceed .25 inches after the discharge is completed. Insulated enclosure shall have a thermal resistance value of 8.0. Provide U.L. STND. 943-NEMA 3R, GFI protected receptacle, mounted at least 30” above the bottom of the enclosure.

C. Install tamper switches on each shutoff valve. Tamper switches shall have waterproof NEMA 6P construction with watertight conduit fittings.
D. Support backflow preventers, valves, and piping on concrete piers.

3.6 ADJUST AND CLEAN

A. Sprinkler Piping Flushing: Prior to connecting sprinkler risers for flushing, flush water feed mains, lead-in connections and control portions of sprinkler piping. After fire sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system, as required to remove foreign substances, under pressure as specified in ANSI/NFPA 13 and 24. Continue flushing until water is clear, and check to ensure that debris has not clogged sprinklers.

3.7 FIELD QUALITY CONTROL

A. Hydrostatic Testing: After flushing system, test fire sprinkler piping hydrostatically for a period of 2 hours, at not less than 200 psi or at 50 psi in excess of maximum static pressure when maximum static pressure is in excess of 150 psi. Check system for leakage of joints. Measure hydrostatic pressure at low point of each system or zone being tested.

B. Test exterior piping in accordance with NFPA 24.

C. Repair or replace piping system as required to eliminate leakage in accordance with ANSI/NFPA standards for "little or no leakage", and retest as specified to demonstrate compliance.

3.8 EXTRA STOCK

A. General: For each style and temperature range required, furnish additional sprinkler heads, amounting to two units for every 100 installed units, but not less than six units of each. The sprinklers shall be kept in a cabinet located where temperatures do not exceed 100°F. A special sprinkler wrench shall be provided for each type of sprinkler installed and shall be kept in the cabinet.

B. Operating Instructions: The Contractor shall provide the Owner with:

1. All literature and instructions provided by the manufacturer describing proper operation and maintenance of all equipment and devices installed.

END OF SECTION 21 00 00
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes hangers and supports for mechanical system piping and equipment.

1.3 DEFINITIONS
A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS
A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
B. Welding Certificates: Copies of certificates for welding procedures and operators.

1.5 QUALITY ASSURANCE
A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Firms regularly engaged in manufacture of supports and hangers, of types and sizes required, whose products have been in satisfactory use in similar service.
2.2 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

1. Nonmetallic Coatings: On hangers for electrolytic protection where hangers are in direct contact with copper tubing.

2.3 MISCELLANEOUS MATERIALS

A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

D. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).

E. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500), if longer ends are required for riser clamps.

F. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification 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 degrees F (49 to 232 degrees C) piping installations.

3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
G. Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.

H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

I. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

J. Thermal-Hanger Shield Inserts:
   1. Description: 100 psig (690 kPa) minimum, compressive-strength insulation insert encased in sheet metal shield.
   2. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
   3. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
   4. For Hangers and Clamped Systems: Insert and shield shall cover entire circumference of pipe.
   5. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. All hangers for equipment and piping are to be supported from building structure even if structural enhancements to roof support is required.

B. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.

C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. 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.

F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
H. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

I. Support vertical piping at each floor and roof.

J. Insulated Piping: Comply with the following:
   1. All hangers and supports shall be external of insulation.
   2. Install MSS SP-58, Type 40 protective shields on all insulated piping. Shields shall span arc of 180 degrees.
   3. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2 (DN8 to DN90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
      b. NPS 4 (DN100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
      c. NPS 5 and NPS 6 (DN125 and DN150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
      d. NPS 8 to NPS 14 (DN200 to DN350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Field Welding: Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

C. Any vertical structural members required to form overhead attachments for hangers or equipment supports shall be located adjacent to walls and any horizontal members be adjacent to the roof structure.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
3.6 PAINTING

A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Sections.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint.

END OF SECTION 23 05 00
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems
2. Dielectric fittings
3. Flexible connectors
4. Sleeves
5. Escutcheons
6. Grout
7. Mechanical demolition
8. Equipment installation requirements common to equipment sections
9. Painting and finishing
10. Concrete bases
11. Supports and anchorages
12. Access panels
13. Anti-huffing devices
14. Locking Thermostat covers

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Except as otherwise defined in greater detail, the term "provide" means furnish and install, complete in every respect and ready for the intended use, as applicable in each instance.

I. "Inspect": The term "inspect" or "inspection: when used to describe observation of the Contractor's Work by the Engineer shall mean an endeavor to guard the Owner against defects and deficiencies in the Work and to determine, in general, if the Work is being performed in a manner such that, when completed, it will be in accordance with the Contract Documents.

J. Wiring: the term "wiring" shall include providing raceway, conductors, and cable in accordance with the requirements of Division 26.

K. The following are industry abbreviations for plastic materials:
   2. PVC: Polyvinyl chloride plastic.

L. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Dielectric fittings.
   2. Escutcheons.

B. Shop Drawings: Detail fabrication and installation for metal supports and anchorage for mechanical materials and equipment.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Equipment Selection: Equipment of higher electrical characteristics, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are appropriately modified. The Contractor will be responsible for any added costs for such modifications. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.
C. Drawings: The Mechanical Drawings show the general arrangement of piping, equipment, and appurtenances, and shall be followed as closely as actual building construction and the work of other trades will permit. The Mechanical work shall conform to the requirements shown on all the Drawings. Because of the small scale of the Mechanical Drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. The Contractor shall investigate the structural and finish conditions and other building components affecting the work and shall arrange his work accordingly, providing such offsets, fittings, and accessories as may be required to meet such conditions. No extras will be approved for required additional offsets and fittings. Any offsets or additional fittings required to coordinate mechanical systems with existing conditions and other trades, or that are necessary for the complete installation of the system, including modifications to shop or off-site fabricated piping and/or ductwork, all shall be provided by the Contractor at no additional cost to the Owner.

D. Codes and Standards: comply with the following codes. Comply with the latest edition except where indicated otherwise or a specific edition is required by the authority having jurisdiction:

1. International Building Code
2. International Mechanical Code
3. International Plumbing Code with Louisiana Amendments
4. Louisiana State Energy Code
5. NFPA 70, 72, 90A, 90B, 96, and 101
6. All applicable local codes

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.7 COORDINATION

A. Coordinate mechanical equipment installation with other building components and existing conditions.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
E. Coordinate connection of mechanical systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Costs for all utility connections shall be the Contractor's responsibility, including any connections made by the utility company.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces.

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and other concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by firms regularly engaged in the manufacture of products required, whose products have been in satisfactory use in similar service.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 Piping Sections and "Pipe and Fitting Material Schedule" on the Drawings for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 Piping Sections and "Pipe and Fitting Material Schedule" on the Drawings for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BAg1, silver alloy.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
3. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, flanged, solder-joint, plain, or weld-neck end connections that match piping system materials and isolate joined dissimilar metals to prevent galvanic action and stop corrosion.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 degrees F (107 degrees C).

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.
E. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

2.8 ACCESS PANELS

A. Access Panels (Toilet and Bath Rooms): Flush stainless steel, 180 degrees door with concealed hinges, key-actuated lock, frame and flexible anchor straps.

B. Access Panels: (Elsewhere): Flush metal hinged access panel and frame (type as required for surface encountered), prime coat finish, and key actuated cylinder lock.

C. Access Panels: Minimum size 12 inch x 12 inch. Locate over device to be serviced.

2.9 ANTI HUFFING DEVICES

A. Provide locking access port caps for all outdoor equipment containing refrigerant. Caps shall be tamper resistant and secured to prevent unauthorized access.

2.10 LOCKING THERMOSTAT COVERS

A. Provide clear thermoplastic locking cover and base for all thermostats. All covers shall be keyed alike. Provide 5 (five) keys to owner.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

A. Refer to Division 1 Sections, "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Install components with pressure rating equal to or greater than system operating pressure.

C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. Install couplings according to manufacturer's written instructions.

G. 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 Coordination Drawings.

H. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

I. Install all buried water piping, regardless of content, a minimum of 12 inches below and 12 inches laterally from any buried electrical line. Whether in conduit or direct buried cable, this requirement shall apply regardless of voltage of the electrical line.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

K. Install piping to permit valve servicing.

L. Install piping at indicated slopes.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Pulled-tee, extruded-tee, thread-o-let, weld-o-let, and mitered elbow connections are not acceptable, unless specifically indicated otherwise. Provide manufactured tee and elbow fittings.

P. Install tees with removable threaded cleanout plugs at each change in direction in all condensate drain piping.
Q. Select system components with pressure rating equal to or greater than system operating pressure.

R. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: Cast-brass type with chrome-plated finish, split-casing for existing piping, and one-piece for new piping.
   c. Insulated and Bare Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
   d. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

S. Sleeves are not required for core-drilled holes.

T. Permanent sleeves are not required for holes formed by removable PE sleeves.

U. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

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 (50 mm) above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
   b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating interior walls.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section, "Sheet Metal Flashing and Trim" for flashing.

   1) Seal space outside of sleeve fittings with grout.

4. Seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

V. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section, "Through-Penetration Firestop Systems" for materials.

W. Verify final equipment locations for roughing-in.
3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements, Division 23 Sections, and Schedules on the Drawings, specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. 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 unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.
   5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Non-Pressure Piping Gasketed Joints: Join according to ASTM D 3212.
3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Manufacturer's Installation and Operating Instructions: All equipment and material shall be installed and operated in strict accord with manufacturer's "Installation and Operating Instructions." The manufacturer's installation instructions shall become part of this Specification, and shall take precedence over and/or supplement any Specification herein and as shown and/or described on plans. All individual items of equipment and components thereof shall be 100 percent accessible for repair, removal, or replacement without functional impairment or dismantling of any adjoining major surfaces or assemblies.

B. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment to allow right of way for piping installed at required slope.

F. Cut and drill floors, roofs, walls, partitions, ceilings, and other surfaces as required to permit installation of mechanical piping, ducts, and equipment. Perform cutting by skilled mechanics of trades involved.

G. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

H. Electrical Work: Wherever equipment requiring electrical power connection is specified, all wiring shall be furnished and installed under Division 26 of the Specifications. Starting switches, protective devices, and other means for the operation and control of equipment shall be furnished under the various Division 23 Sections, and installed and electrically connected complete under Division 26 unless otherwise specifically noted, except that control devices that are installed in or on ducts, piping, or mechanical equipment shall be mounted under Divisions 23. If equipment is furnished requiring power wiring different from that indicated on the
Electrical Drawings, the Contractor furnishing the equipment shall be responsible for any required revisions and pay any additional costs connected therewith. Wiring revisions shall be submitted to the Architect for approval prior to installation.

1. Contractors furnishing items to be wired shall provide adequate wiring diagrams.
2. Temperature control wiring shall be furnished and installed in raceway under Division 23 according to the requirements of Division 26, specifically Section, "Conductors and Cables," and Section, "Raceways and Boxes."

3.6 EARTHWORK

A. Refer to Division 2 Section, "Earthwork" for excavation, trenching and backfilling.

3.7 PAINTING

A. Touching Up: 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 (0.05 mm).

B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section, "Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.8 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
   2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   3. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section, "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
C. Field Welding: Comply with AWS D1.1.

3.10 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.11 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.12 MISCELLANEOUS

A. Access Panels: Provide access panels as indicated. In addition, provide access panels for each concealed item requiring service or adjustment that would otherwise be inaccessible whether shown or not. Access panel locations shown on drawings are approximate. Exact location shall be verified with the Architect prior to installation. Deliver access panels to trade responsible for finish surfaces in which access panels are to be installed.

END OF SECTION 23 01 00
SECTION 23 01 30 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.2 QUALITY ASSURANCE

A. Comply with the National Air Duct Cleaners Association (NADCA) ACR 2013 Standard for all work of this section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.

B. Comply with NADCA ACR 2013, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.2 CLEANING

A. Comply with NADCA ACR 2013.

B. Remove visible surface contaminants and deposits from within the HVAC system.

C. Systems and Components to Be Cleaned:
   1. Air devices for supply, outside, return air and exhaust.
   2. Ductwork:
      a. Existing Exhaust-air ducts.
      b. Existing Outside-air ducts.
      c. Air distribution devices including diffusers, registers, grilles, and louvers.

D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.

E. Particulate Collection:
F. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.

G. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building.

H. Control odors and mist vapors during the cleaning and restoration process.

I. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.

J. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.

K. Clean all air-distribution devices, registers, grilles, and diffusers.

L. Clean visible surface contamination deposits according to NADCA ACR 2013 and the following:
   1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
   2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
   3. Clean evaporator coils, reheat coils, and other airstream components.

M. Duct Systems:
   1. Create service openings in the HVAC system as necessary to accommodate cleaning.
   2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2013).

N. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

O. Mechanical Cleaning Methodology:
   1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.

b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

3.3 RESTORATION

A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2013, "Restoration and Repair of Mechanical Systems" Section.

B. Comply with Section 23 31 13 "Metal Ducts" for duct materials, accessories, and hardware required for Work of this Section.

C. Ensure that closures do not hinder or alter airflow.

D. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

END OF SECTION
SECTION 23 02 00 - MOTORS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes basic requirements for factory-installed and field-installed motors.
   B. Related Sections include the following:
      1. Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.3 SUBMITTALS
   A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.
   B. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

1.4 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.
   B. Comply with NFPA 70.

1.5 COORDINATION
   A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
      1. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
2. Matched to torque and horsepower requirements of the load.

3. Matched to ratings and characteristics of supply circuit and required control sequence.

PART 2 - PRODUCTS

2.1 MOTOR CHARACTERISTICS

A. Motors 1/2 HP and Larger: Three phase.

B. Motors Smaller Than 1/2 HP: Single phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Duty: Continuous duty at ambient temperature of 105 degrees F (40 degrees C) and at altitude of 3300 feet (1005 meters) above sea level.

F. 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.

G. Enclosure: Open drip-proof, unless otherwise indicated.

2.2 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Energy-Efficient Design: All motors.


2. Comply with EPACT.

C. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.
G. Insulation: Class F, unless otherwise indicated.

2.3 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.

2. Temperature Rise: Matched to rating for Class B insulation.

3. Insulation: Class H.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.


2.4 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. 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.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

PART 3 - EXECUTION

3.1 MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer’s written instructions. Attach by bolting. Level and align with load transfer link.
3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.

2. Test interlocks and control features for proper operation.

3. Verify that current in each phase is within nameplate rating.

3.3 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION
SECTION 23 05 53 - MECHANICAL IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes mechanical identification materials and devices.

1.3 SUBMITTALS

A. Product Data: For identification materials and devices.

B. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

A. General: Products specified are for applications referenced in other Division 23 Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.

2. Location: Accessible and visible.

C. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
D. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers, extending 360 degrees around pipe at each location.

E. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers, at least 3 times letter height and of length required for label.

F. Lettering: Manufacturer's standard preprinted captions as selected by Engineer.
   1. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.

G. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils (0.08 mm) thick.
   1. Width: 1-1/2 inches (40 mm) on pipes with OD, including insulation, less than 6 inches (150 mm); 2-1/2 inches (65 mm) for larger pipes.
   2. Color: Comply with ASME A13.1, unless otherwise indicated.

H. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
   1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
   2. Thickness: 1/16 inch (2 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) in length, and 1/8 inch (3 mm) for larger units.
   3. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

I. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
   1. Green: Cooling equipment and components.
   2. Yellow: Heating equipment and components.
   4. Blue: Equipment and components that do not meet criteria above.
   6. Terminology: Match schedules as closely as possible. Include the following:
      a. Name and plan number.
      b. Equipment service.
      c. Design capacity.
      d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
   7. Size: 2-1/2 by 4 inches (65 by 100 mm) for control devices and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
J. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

PART 3 - EXECUTION

3.1 LABELING AND IDENTIFYING PIPING SYSTEMS

A. Install pipe markers on each system. Include arrows showing normal direction of flow.

B. Marker Type: Plastic markers, with application systems.

C. Fasten markers on pipes and insulated pipes smaller than 6 inches (150 mm) OD by one of following methods:
   1. Snap-on application of pre-tensioned, semi-rigid plastic pipe marker.

D. Fasten markers on pipes and insulated pipes 6 inches (150 mm) in diameter and larger by one of following methods:
   1. Laminated or bonded application of pipe marker to pipe or insulation.
   2. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 1-1/2 inches (40 mm) wide, lapped a minimum of 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.
   3. Strapped to pipe or insulation with manufacturer's standard stainless-steel bands.

E. Locate pipe markers and color bands where piping is exposed; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations according to the following:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs. Mark each pipe at branch, where flow pattern is not obvious.
   3. Near penetrations through walls, floors, ceilings, or nonaccessible 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 a maximum of 50-foot (15-meters) intervals along each run. Reduce intervals to 25 feet (7.5 meters) in areas of congested piping and equipment.
3.2 EQUIPMENT SIGNS AND MARKERS

A. Install engraved plastic-laminate signs or equipment markers on or near each major item of mechanical equipment. Include signs for the following general categories of equipment:

   1. Variable refrigerant volume split system heat pumps units (inside and outside units)
   2. Air Handling units
   3. Fans

3.3 ADJUSTING AND CLEANING

A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.

B. Clean faces of identification devices and glass frames of valve charts.

END OF SECTION 23 05 53
SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

1.2 DESCRIPTION OF WORK

A. The extent of test-adjust-balance (TAB) work is indicated by the requirements of this Section, and also by Drawings and Schedules, and is defined to include, but is not necessarily limited to, air distribution systems, and associated equipment and apparatus of HVAC work. The work consists of setting speed and volume (flow) adjusting facilities provided for the systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to the work as required by the Contract Documents.

B. The component types of testing, adjusting and balancing specified in this Section includes the following as applied to HVAC equipment:

1. Split system air conditioning units, heat pumps and evaporator units
2. Fans
3. Ductwork systems
4. Grilles, registers, and diffusers
5. Air Units
6. Temperature Controls

1.3 QUALITY ASSURANCE

A. Installer: A TAB firm with at least 3 years of successful test-adjust-balance experience on projects with testing and balancing requirements similar to those required for this project who is not the Installer of system to be tested and is otherwise independent of the project.

B. NEBB Compliance (Option): Comply with NEBB's "Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems" as applicable to HVAC air distribution systems and associated equipment and apparatus.

C. AABC Compliance (Option): Comply with AABC's Pub. No. 12173, "National Standards for Field Measurements and Instrumentation, Total System Balanced", as applicable to HVAC air and hydronic distribution system and associated equipment and apparatus.

D. Industry Standards: Comply with ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) recommendations pertaining to measurements, instruments and testing, adjusting, and balancing, except as otherwise indicated.
1.4 SUBMITTALS

A. Submit certified test report signed by the Test and Balance Supervisor who performed the TAB work.

B. Include identification and types of instruments used and their most recent calibration date with submission of final test report.

1.5 JOB CONDITIONS

A. Do not proceed with testing, adjusting, and balancing work until the work to be TAB'ed has been completed and is operable. Ensure that there is no latent residual work still to be completed.

B. Do not proceed until the work scheduled for TAB'ing is clean and free from debris, dirt, and discarded building materials.

PART 2 - PRODUCTS

2.1 PATCHING MATERIALS

A. Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housing which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

B. At Tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

2.2 TEST INSTRUMENTS

A. Utilize test instruments and equipment for the TAB work required, of the type, precision, and capacity as recommended in the following TAB standards:


2. AABC's National Standards for Field Measurements and Instrumentation, Total Balance System.

PART 3 - EXECUTION

3.1 GENERAL

A. Tester must examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjust-balance work.
B. Do not proceed with the TAB work until unsatisfactory conditions have been corrected in a manner acceptable to the Tester.

C. Test, adjust and balance the environmental systems and components, as indicated, in accordance with the procedures outlined in applicable standards. In addition perform the following:

1. Test all safety devices for proper operation.
2. Adjust gas burners and gas inputs per manufacturer's recommendations.
3. Calibrate temperature control systems and adjust heat anticipators per manufacturer's recommendations.
4. Test smoke detector as recommended by manufacturer.

D. Test, adjust and balance system during the summer for air conditioning systems and during winter for heating systems, including at least a period of operation at outside conditions within 5 degrees F wet bulb temperature of maximum summer design condition, and within 10 degrees F dry bulb temperature of minimum winter design condition. When seasonal operation does not permit measuring the final temperatures then take the final temperature readings when the seasonal operation does permit.

E. Prepare report of test results, including instrumentation calibration reports, in format recommended by the applicable standards. In addition certify that safety devices have been checked and are operating properly, that gas inputs and gas burners have been adjusted in accord with manufacturer's recommendations, that temperature control systems have been calibrated and are operating properly, that smoke detector is operating properly, and that heat anticipators have been adjusted in accord with manufacturer's recommendations.

F. Patch holes in insulation, ductwork, and housings, which have been cut or drilled for test purposes, in a manner recommended by the original Installer.

G. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

H. Prepare a report of recommendations for correcting unsatisfactory HVAC performances when system cannot be successfully balanced.

I. Retest, adjust, and balance system subsequent to significant system modifications or if report is unsatisfactory, and resubmit test results. Repeat until satisfactory results are obtained.

END OF SECTION 23 05 93
SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 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.

B. Related Sections:

1. Section "Pipe Insulation for HVAC."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


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 C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I, Type II with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Friendly Feel Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; SOFTR All-Service Duct Wrap.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.
2.2 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges - Marathon Industries; 225.
      d. Mon-Eco Industries, Inc.; 22-25.

   2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive 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."

   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges - Marathon Industries; 225.
      d. Mon-Eco Industries, Inc.; 22-25.

   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive 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."

2.3 MASTICS

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:
   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.


C. 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:
   b. Eagle Bridges - Marathon Industries; 550.
   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.


2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:
   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).
7. Sealants 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."

2.5 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. 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 the following:
   b. Vimasco Corporation; Elastafab 894.

2.7 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.

2.8 TAPES

A. 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.

B. 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.

2.9 SECUREMENTS

A. Insulation Pins and Hangers:

1. 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: 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.

2. 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. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

   1) GEMCO; Nylon Hangers.
   2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.

c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. 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. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

   1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
   2) GEMCO; Peel & Press.
   3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

d. Adhesive-backed base with a peel-off protective cover.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

   1) AGM Industries, Inc.; RC-150.
   2) GEMCO; R-150.
   3) Midwest Fasteners, Inc.; WA-150.
   4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) GEMCO.
      2) Midwest Fasteners, Inc.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, galvanized steel.

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:

2.10 CORNER ANGLES

A. 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

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

C. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

D. 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.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Keep insulation materials dry during application and finishing.

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 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.

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- (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.

M. Cut insulation in a manner to avoid compressing insulation more than 75 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 (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
3.3 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).
   1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

3.4 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.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. 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.

3.6 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. Fire-stop systems are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.7FINISHES

A. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

B. Do not field paint aluminum or stainless-steel jackets.

3.8FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, 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 duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 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.
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.
5. Flexible connectors.
7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

D. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches (75 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

E. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

F. Exposed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

3.11 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.

END OF SECTION
SECTION 23 07 19 - PIPE INSULATION FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

   A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

   B. Related Sections include the following:

      1. Division 23 Section, "Duct Insulation" for insulation for ducts and plenums.
      2. Division 23 Section, "Hangers and Supports" for pipe insulation shields and protection saddles.

1.3 SUBMITTALS

   A. Product Data: Identify thermal conductivity, thickness, and jackets, for each type of product indicated.

   B. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.4 QUALITY ASSURANCE

   A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

   B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING

   A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
1.6 COORDINATION
A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section, "Hangers and Supports for HVAC."
B. Coordinate clearance requirements with piping Installer for insulation application.
C. Coordinate installation and testing of steam or electric heat tracing.

1.7 SCHEDULING
A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, manufacturers regularly engaged in the manufacture of piping insulation products of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

2.2 INSULATION MATERIALS
A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
   1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
   2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
   3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
      a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
      b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
   1. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
A. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Adhesive: As recommended by insulation material manufacturer.
2. **Ultraviolet-Protective Coating:** As recommended by insulation manufacturer.

2.3 **FIELD-APPLIED JACKETS**

A. **PVC Jacket:** High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; pre-curved ready for shop or field cutting and installing.

   1. **Adhesive:** As recommended by insulation material manufacturer.
   2. **PVC Jacket Color:** White or gray.

B. **Standard PVC Fitting Covers:** Factory-fabricated fitting covers manufactured from 20-mil-(0.5 mm-) thick, high-impact, ultraviolet-resistant PVC.

   1. **Shapes:** 45 and 90 degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
   2. **Adhesive:** As recommended by insulation material manufacturer.

2.4 **ACCESSORIES AND ATTACHMENTS**

A. **Glass Cloth and Tape:** Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd. (270 g/sq. m).

   1. **Tape Width:** 4 inches (100 mm).

B. **Bands:** 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

   2. **Stainless Steel:** ASTM A 666, Type 304; 0.020 inch (0.5 mm) thick.

C. **Wire:** 0.080 inch (2.0 mm), nickel-copper alloy; 0.062 inch (1.6 mm), soft-annealed, stainless steel; or 0.062 inch (1.6 mm), soft-annealed, galvanized steel.

2.5 **VAPOR RETARDERS**

A. **Mastics:** Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

   B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Seal joints and seams with vapor-retarder mastic.

G. Keep insulation materials dry during application and finishing.

H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

I. Apply insulation with the least number of joints practical.

J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.
2. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
3. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

L. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

N. Apply insulation with integral jackets as follows:
   1. Pull jacket tight and smooth.
   2. Circumferential Joints: Cover 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 and spaced 4 inches (100 mm) o.c.
   3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply 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 (100 mm) o.c.
      a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
   4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
   5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

O. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

P. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
   1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
   2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.
   3. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:
   1. Apply preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.

3. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body to thickness equal to adjoining pipe insulation. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.

3. Apply insulation to flanges as specified for flange insulation application.

4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.

2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Apply PVC jacket over all piping, fittings, valves, flanges, etc. located in equipment rooms and mechanical rooms, up to an elevation of 6'-0" above the finished floor of the space. Apply with 1 inch (25 mm) overlap at longitudinal seams and end joints. Seal with manufacturers' recommended adhesive.

3.7 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.
2. Vibration-control devices.

3.8 FIELD QUALITY CONTROL

A. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

B. Reinstall insulation and covers on fittings and valves if required to be uncovered for inspection according to these Specifications.

3.9 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.10 INTERIOR INSULATION APPLICATION SCHEDULE

A. This application schedule is for interior insulation inside both the main building and the equipment building on the roof.

B. Service: Condensate drain piping.

1. Operating Temperature: 35 to 75 deg F (2 to 24 deg C).
2. Insulation Material: Flexible elastomeric.
5. Vapor Retarder Required: Yes.
6. Finish: None.

C. Service: Refrigerant suction and vapor piping.

1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
2. Insulation Material: Flexible elastomeric.
4. Finish: None.

D. Service: Exposed sanitary drains and domestic water supplies and stops for fixtures for the disable.

1. Insulate and jacket with factory insulation and white PVC jacket kit conforming to ADA and equivalent to Truebro “Handi Lav-Guard”, McGuire Manufacturing Co. “ProWrap”, or approved equivalent.
3.11 EXTERIOR INSULATION APPLICATION SCHEDULE

A. This application schedule is for aboveground insulation outside the building.

B. Service: Refrigerant suction.

1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
2. Insulation Material: Flexible elastomeric.

END OF SECTION 23 07 19
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work specified in this Section.

1.2 SUMMARY

B. This section describes the Enterprise Level Energy Management Systems (ELEMS) scope of work for the project. This section also coordinates the responsibilities of the Mechanical and Electrical trade contractors pertaining to control products or systems, furnished by each trade that will be integrated by this Division.

C. All labor, material, equipment, programming, graphics and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

1. All controllers, field devices, equipment interfaces, etc. furnished shall be BACnet Testing Laboratory (BTL) Listed.

D. The system network will be BACnet/MSTP or BACnet/IP. No Exceptions will be made.

1. All controllers, field devices, equipment interfaces, etc. furnished shall be BACnet Testing Laboratory (BTL) Listed.

1.3 QUALITY ASSURANCE

A. Codes and Approvals:

1. The complete BMCS installation shall be in strict accordance to the national and local electrical codes and the electrical Section of these specifications. All devices designed for or used in line voltage applications shall be UL listed. All microprocessor based remote and central devices connecting onto the primary bus (including link devices) shall be UL-Listed.

2. The system shall comply with NFPA 90A Air Conditioning and 90B Warm Air Heating, Air Conditioning.

3. Operator work station, supervisory and field level controllers and devices shall have BTL listing. Provide satisfactory operation without damage at 110 percent above and 85 percent below rated voltage and at 3 hertz variation in line frequency. Provide static, transient, and short circuit protection on all inputs and outputs. Communication lines shall be protected against incorrect wiring, static transients, and induced magnetic
interference. All bus connected devices shall be a.c. coupled, or equivalent, so that any single device failure will not disrupt or halt bus communication.

B. Acceptance: The BMCS Contractor shall completely check out, calibrate, and test all connected hardware and software to insure that the system performs in accordance with the approved Specifications and sequences of operations approved.

1. Witnessed acceptance demonstration shall display and demonstrate each type of data entry to show site specific customizing capability; demonstrate parameter changes; execute digital and analog commands; and demonstrate DDC loop stability via trend of inputs and outputs.

2. The Control Contractor shall furnish software for the laptop computer to enable service of the control system and for use by the balancing Contractor during system balancing. The Control Contractor shall provide the balancing Contractor up to four hours training on the use of this software in order to exercise actuators and enter calibration and balancing parameters. Additional training or assistance required by the balancing Contractor shall be contracted directly with the Control Contractor by the balancing Contractor.

C. Submittals:

1. Submit 5 complete sets of documentation in the following phased delivery schedule:
   a. Technician current license for Tridium Niagara Web Supervisor.
   b. Valve and damper schedules
   c. Equipment data cut sheets including BTL listing documentation.
   d. System schematics, including:
      1) Sequence of operations
      2) Point names
      3) Point addresses
      4) Point to point wiring
      5) Interface wiring diagrams
      6) Panel layouts
      7) System riser diagrams
   e. AutoCAD compatible or equal as-built drawings

2. Upon project completion, provide owner with BMCS programming software and submit operation and maintenance manuals, consisting of the following:
   a. Manufacturer's equipment parts list of all functional components of the system
   b. Description of sequence of operations
   c. As-Built interconnection wiring diagrams
   d. User’s documentation containing product, system architectural and programming information.
   e. Trunk cable schematic showing remote electronic panel locations, and all trunk data
f. List of connected data points, including panels to which they are connected and input device

g. Conduit routing diagrams

h. Copy of the warranty

i. Operating and maintenance cautions and instructions

j. Recommended spare parts list

k. Backup of all software and system programming, including supervisor and field devices so that the owner can restore system.

D. Training: All training shall be by the BMCS Contractor and shall utilize Operator's Manuals and as-built documentation.

1. Operator training for the project shall include two (2) eight-hour session encompassing modifying text and graphics, sequence of operation review, selection of all displays and reports, use of all specified OWS functions, troubleshooting of sensors (determining bad sensors), and password assignment and modification

   a. This training session shall be conducted at system completion including BTL listing documentation.

E. Warranty:

1. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of two years from the time of system acceptance.

2. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the Division 23 contractor at no expense to the Owner.

1.4 BUILDING MANAGEMENT AND CONTROL SYSTEM

A. The Building Management and Control System (BMCS) as provided in the Division shall be based on the Niagara Framework (or “Niagara”), a Java-based framework. Niagara provides an open automation infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard or software) into a unified platform that can be easily managed in real time over the Internet using a standard Web browser. Systems not developed on the Niagara Framework platform are unacceptable.

B. Manufacturers: Provide BMCS software and components by one of the following manufacturers:

   1. Automated Logic
   2. Honeywell
   3. Siemens

C. The Building Management and Control System (BMCS) shall be comprised of Network Area Controller or Controllers (NAC) within facility. The NAC shall connect to the owner’s wide area network. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local
area network. Each NAC shall communicate to BACnet control devices provided under Division 23.

D. Provide manufacturers most recent software.

E. Manufacturer: Firms regularly engaged in manufacture of electric-electronic temperature control equipment, of types and sizes which are similar to required equipment, and which have been in satisfactory use in similar service for not less than 5 years. Manufacturer shall have an established factory authorized service organization in Shreveport, Louisiana.

F. Installer: A firm specializing and experienced in electric-electronic control system installations for not less than 5 years.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General: Provide electric-electronic temperature control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide Manufacturer's standard temperature control system components as indicated by published product information, designed and constructed as recommended by Manufacturer. Provide temperature control systems with the following functional and construction features as indicated.

B. Control Valves: Provide factory-fabricated electrical control valves of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by Manufacturer for installation requirements and pressure class, based on maximum pressure and temperature rating of piping system. Except as otherwise indicated, provide valves which mate and match material of connecting piping. Equip control valves with control valve motors, and with proper shutoff ratings for each individual application. All valves shall be proportional control, except for fan coil units which shall be on/off.

C. Water Service Valves: Equal percentage characteristics with range of 50 to 1.

D. Single-Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.

E. Valve Trim and Stems: Polished stainless steel for all sizes, trim as recommended by Manufacturer.

F. Packing: Spring-loaded Teflon, self-adjusting.

G. Contractor shall provide all required software and peripherals for programming and commissioning field and supervisory controllers.

1. Software manufacturer shall provide on-site, project specific training of not less than 16 additional hours.
2. All software and licenses shall be open and free at no additional cost to the owner for life.
3. Upon substantial completion, the contractor shall upgrade all server and field devices to most current revision. Contractor shall re-verify all control sequencing after upgrade.

H. All Applied controllers shall be Bacnet/IP controllers and will require an IT connection furnished by the installing contractor and that must be coordinated with the owners IT department.

2.2 JACE EQUIPMENT CONTROLLER (JEC)

A. Provide an IP based Equipment controller based on the Tridium the NiagaraAX Framework® JACE and Integral IO Modules. The JACE Equipment Controller (JEC) shall be an embedded controller/server platform designed for monitoring and control applications. The unit shall support integrated control, supervision, data logging, alarming, and scheduling, 34 points of IO, with Internet connectivity and web serving capabilities. The JEC shall support all Niagara bases programming tools and integrate with Niagara based supervisory servers utilizing the Fox protocol.

B. The JEC shall provide applications for controlling and monitoring building systems including HVAC equipment, lighting, and meters. An integral 34 point IO module shall be provided with each controller. The Input/Output module shall provide 34 points for local control. In addition to local control, the JEC shall be licensed for up to 5 remote devices that can come into the controller via Lon, BACnet, or Modbus. The JEC shall serve data and rich graphical displays to a standard web browser via an Ethernet LAN or remotely over the Internet. Where specified, AX Supervisor™ software can be used to aggregate information (real-time data, history, alarms, etc.) from large numbers of JECs into a single unified application to manage global control functions, support data passing over multiple networks, connect to enterprise level software applications, and host multiple, simultaneous client workstations connected over the local network, the Internet.

C. Features shall include

1. Web User interface shall serve rich presentations and live data to any browser
2. Supports simultaneous stand-alone control, energy management, and multi-protocol integration
3. BTL® listed when BACnet driver is used – shall comply with B-BC (BACnet Building Controller)
4. Built-in 24 volt AC/DC input power supply
5. Support for 2 additional onboard 16 point IO modules and 4 additional 16 point remote IO modules
6. Pre-Licensed for five total remote devices – integrated via BACnet
7. Din Rail mountable for quick installation
8. IO-34 - 34 Point I/O Module
   a. 16 Universal Inputs (Type 3 (10k) Thermistors, 0-1000 ohm, 0-10 volts, 0-20 mA with external resistor)
   b. 10 relay outputs (Form A contacts, 24 VAC @.5 amp rated)
   c. 8 analog outputs (0-10 vlt DC)
9. Communications
a. 2 Ethernet Ports – 10/100 Mbps (RJ-45 Connectors)
b. 1 RS 232 Port (RJ-45 Connector)
c. 1 RS 485 non isolated port (Screw Connector on base board)
d. 2 card slots for optional communication cards

D. Provide all necessary hardware, software, and programming for the specified sequence of operation, graphics, alarms, histories, and trends. Provide JEC with the Tridium open NIC for connection by any Niagara AX based engineering tool.

2.3 SENSORS

A. System and Sensor Accuracy: The system shall maintain an end to end accuracy for two years from sensor to diagnostic display for the applications specified.

1. Space temperature with a range of 50 to 85 degrees F, plus or minus 0.75 degrees F for conditioned space.
2. Outside Air (OA) temperature with a range of minus 40 to plus 130 degrees F, plus or minus 2.0 degrees F, with a sub-range of plus 30 to 100 degrees F, plus or minus 1.0 degree F.
3. Water temperature with a range of 30 to 100 degrees F, plus or minus 0.75 degrees F; the range of 100 to 250 degrees F within plus or minus 2.0 degrees F

B. Temperature Sensors: Temperature sensors shall be resistance temperature detectors (RTD's). Sensing element shall be nickel with common reference of 1000 ohms at 70 degrees F. Provide sensing elements as follows:

1. Liquid immersion RTD shall be provided with brass thermowell. Length of sensor and thermowell shall be selected based on diameter of pipe to facilitate accurate, reliable, homogeneous and steady temperature sensing of the liquids.
2. Room temperature sensors shall have setpoint adjusters with no thermometer.

C. Current Sensing Status Relays: The on and off status of each pump motor and fan motor shall be indicated via a current sensing relay and current transformer on one of the power legs to the associated motor. Relay shall provide dry contact closure with motor on but shall indicate open contact whenever fan belt breaks or if the motor fails to run. Current sensing relay and start/stop relay shall not be combination type.

2.4 VALVE AND DAMPER OPERATORS:

A. Valve operators shall be electronic type. Operator shall be designed for maximum pressure differential or torque required (plus 50 percent) across the valve. Valve operators shall be complete with feedback position indicator for interface to DDC controller. Operators shall be spring return type to fail safe in event of signal or power loss.

2.5 LOCAL CONTROL PANELS:

A. Provide a central control panel located in the mechanical room with suitable brackets for wall mounting. Locate panel adjacent to systems served.
B. Provide standard steel cabinets as required to contain temperature controllers, relays, switches, and similar devices, except limit controllers and other devices excluded in sequence of operations. Provide full-enclosure cabinets with painted gray finish.

PART 3 - EXECUTION

3.1 INSTALLATION AND WIRING

A. General: Install system and materials in accordance with Manufacturer's instructions and roughing-in Drawings and details on Drawings. Mount controllers at convenient locations and heights.

B. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

C. All wiring, low and line voltage shall be run in conduit. NO EXCEPTIONS

D. The electrical contractor (Div 26) shall furnish all power wiring to electrical starters and motors.

3.2 GRAPHICAL USER INTERFACE

A. Introduction

1. The goal is to provide the end user with a fully functional set of non-proprietary graphics with which to operate, test and troubleshoot their systems with, while still maintaining a standard look and “feel” across all graphics.

B. Base Graphic (Graphic Template)

1. The base of the graphic consists of its background color and title bar. The title bar includes a forward, back, home, schedule, trends, alarm, and help buttons. Outdoor air temperature and humidity (if available) should be on the title bar also.

   a. Standards for the “base” of all graphics should include:

      1) All graphics should be sized to fit nicely on a monitor running 1280x1024 resolution and shall scale to any given resolution.
      2) All graphics should be displayed in Niagara without any scroll bars, when viewed at the resolution listed above.
      3) Display background should be RGB (64, 64, 64) in color.
      4) Display of the frame and navigation tree should be RGB (32, 32, 32) in color.
      5) Interactive navigation tree should be located on the left hand side of every graphic page.

2. The navigation tree graphic should:

   a. Select a unit or summery to view
   b. Customer logo at the top
   c. Controls Contractor logo at the bottom
3. The Unit Name and Job Name should be in Tahoma, 12pt Bold, Black.
   a. Mechanical Equipment

4. All mechanical equipment graphics should match that being used. IE: absorption vs. centrifugal chillers; plate-and-frame vs. tube heat exchangers; sectional vs. fire tube boilers; air-to-air vs. heat wheel heat exchangers.

C. AHU and Duct Work
1. All ducts should be laid out using the appropriate pieces from the 3D library as to ensure all shading, shadows and color variations line up. Inserting a single piece, such as an elbow, and rotating it is not acceptable as this causes misalignment.
2. All duct terminations or “ends” should be labeled as appropriate: OA, DA, SA, EA etc.
   a. Tahoma font
   b. 12 pt Bold
   c. “Black” or RGB (225, 225, 225) in color

D. Sensors
1. All duct sensors, probes and meters of any kind should be animated with a “red” color around the text if the device is in the alarm state and the alarm state is available. This is especially important for freeze-stats and smoke detectors.

E. Dampers
1. Dampers should be animated and the dampers should match the control signal type (use two position dampers for digital control, and modulating dampers for analog control)

F. Heating/Cooling Coils & DX
1. Heating coil type shown should match actual coil type (electric vs. hot water or steam). Bypass piping and pumps should be shown or not shown to match the actual system. Bypass pumps should be animated if the data is available. The percent open will be shown on the coil ex: if the valve is 25% open then 25% of the coil will be shaded red.
2. Cooling coils should match actual coil type (DX vs. chilled water). Bypass piping and pumps should be shown or not shown to match the actual system. Bypass pumps should be animated if the data is available. The percent open will be shown on the coil ex: if the valve is 25% open then 25% of the coil will be shaded blue.

G. Floor Plan Graphics
1. Floor plan graphics consist of 4 major parts:
   a. Base Graphic
   b. 3D Floor Plans
   c. Data
   d. Labeling/Legend
2. The base graphic will follow the standards for “Base Graphics” detailed earlier in this document. The actual floor plan on a graphic should be comprised of 3 parts:
a. Floor Plan Image: This should be a 3D CAD drawing which has been converted to a png image (png images support the “invisible” color). Specific layers of the CAD drawings should be turned off to leave only building wall, door, window and major partitions visible. The color of all visible layers should be Dark Grey RGB (105,105,105)
b. Room Numbering/Labeling
   1) Labels shall include box/room number and change color on a gradient scale up and down in 1 degree increments with dark blue being coldest and red being the hottest.
c. Zoning; this helps visually determine what equipment is serving an area and if the equipment is maintaining a suitable comfort level

3. Data displayed on a floor plan graphic will utilize a custom created dynamic shape. This shape will display space temperature, equipment name and include a link to the equipment. As you place the cursor over a zone, the name of the zone will be located in the frame above the floor plan and can also be edited by the end user. In the event this data is not available for a specific zone, the dynamic shape should not be placed within that space. Upon clicking on the link, the user will navigate to the specific equipment for that zone. All detail pages will utilize the template graphics for terminal units as discussed earlier in this document.

3.3 FINAL ADJUSTMENTS
A. After completion of installation, adjust thermostats, control valves, motors, and similar equipment provided as work of this section.
B. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer (or factory authorized installer) of primary temperature control system. Provide certification that all work has been tested, balanced, and adjusted and that all systems are working as intended.

3.4 POINTS LIST
A. Refer to the Mechanical Drawings.

3.5 SEQUENCE OF OPERATIONS
A. Refer to the Mechanical Drawings.

END OF SECTION 23 09 23
SECTION 23 17 16 - CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes piping for drain lines and condensate drain piping.

B. Related Sections include the following:

1. Division 23 Section, "Basic Mechanical Materials and Methods for HVAC," for general piping materials and installation requirements.
2. Division 23 Section, "Hangers and Supports for HVAC," for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.

1.3 COORDINATION

A. Coordinate layout and installation of drain piping and suspension system components with other construction, including natural gas piping system.

B. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. General: Refer to Piping and Fitting Material Schedule on the Drawings for applications of pipe and fitting materials.

PART 3 - EXECUTION

3.1 PIPING INSTALLATIONS

A. Refer to Division 23 Section, "Basic Mechanical Materials and Methods for HVAC," for basic piping installation requirements.

B. Install drains, consisting of a tee fitting, threaded nipple with threaded cap for system cleanout. Provide cleanout at each change in direction and at connection to unit.
C. Install piping at a uniform grade of 0.2 percent downward in direction of flow.

D. Increase/reduce pipe sizes using eccentric reducer fitting installed with level side down.

E. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe.

3.2 HANGERS AND SUPPORTS

A. Supports are specified in Division 23 Section, "Hangers and Supports for HVAC."

B. Install supports for steel piping with the following maximum spacing and with continuous slope from unit connection to drain line termination.

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 meters).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 meters).
3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 meters).
4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 meters).
5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 meters).
6. NPS 3 (DN 80): Maximum span, 10 feet (3 meters).

3.3 PIPE JOINT CONSTRUCTION

A. Refer to Division 23 Section, "Basic Mechanical Materials and Methods for HVAC," and schedule on the Drawings for joint construction requirements for soldered and brazed joints in copper tubing.

3.4 TERMINAL EQUIPMENT CONNECTIONS

A. Size for piping connections shall be same as for equipment connections. Increase pipe size at connection as indicated on Drawings.

3.5 CLEANING

A. Flush drain piping systems with clean water.

END OF SECTION
SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS
   A. Line Test Pressure for Refrigerant R-410A:

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
      1. Thermostatic expansion valves.
      2. Solenoid valves.
      3. Hot-gas bypass valves.
      4. Filter dryers.
      5. Strainers.
      6. Pressure-regulating valves.

   B. Shop Drawings: 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. Show interface and spatial relationships between piping and equipment.
      1. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50).
      2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual 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.
1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.
B. Field quality-control test reports.
C. Installer’s Certificate of Training from manufacturers of Section equipment.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.8 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.9 COORDINATION

A. Coordinate size and location of concrete pads and, equipment supports.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L.
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.
F. Flexible Connectors:

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. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

G. Flexible Connectors:

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).

2.2 VALVES AND SPECIALTIES

A. 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.
4. End Connections: Copper spring.

B. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

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 24-V ac coil.

C. Straight-Type Strainers:

2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.

D. Moisture/Liquid Indicators:

2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
5. End Connections: Socket or flare.

E. Replaceable-Core Filter Dryers: Comply with ARI 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.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
7. Maximum Pressure Loss: 2 psig (14 kPa).
10. Locking mechanism to prevent huffing.

2.3 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 4 (DN 100) and Smaller for Conventional Air-Conditioning Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with soldered joints.
B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed.

C. Safety-Relief-Valve Discharge Piping: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

B. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

C. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

D. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

E. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

F. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Hot-gas bypass valves.
   4. Compressor.

G. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

H. Install flexible connectors at compressors.

3.3 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. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. 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 08311 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

M. 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.

N. 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.

O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section - Basic Mechanical Material and Methods.

3.4 PIPE 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 pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
   2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

F. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

G. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section "Hangers and Supports for Plumbing and HVAC."

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 the following maximum spacing and minimum rod sizes:
   1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
   2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
   3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
   4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
   5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
2. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9.5 mm).
3. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (9.5 mm).
4. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

E. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. 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 they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
   a. Fill system with nitrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.
3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00
SECTION 23 30 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

1.2 DESCRIPTION OF WORK

A. Extent of ductwork accessories work is indicated on Drawings and in Schedules and by requirements of this Section.

B. Types of ductwork accessories required for project include the following:

1. Low pressure manual dampers.
2. Fire dampers.
3. Turning vanes.
4. Duct hardware.
5. Duct access doors.
6. Flexible connections.

C. Refer to other Division 23 Sections for testing, adjusting, and balancing of ductwork accessories; not work of this Section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible."
2. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers."

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction and installation instructions.

B. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data and product data in maintenance manual; in accordance
PART 2 - PRODUCTS

2.1 DAMPERS


1. Square and Rectangular Dampers: Dampers shall have minimum 16 gauge frames and minimum 16 gauge roll formed blades. Multi-blade dampers shall have interlocking corrugated edges. Damper linkage shall be concealed in the damper frame. Dampers for ducts smaller than 10 inches by 10 inches may be single blade dampers, all other dampers shall have multiple blades. Provide opposed blade type unless indicated otherwise.

2. Round Dampers: Dampers shall be minimum 20 gauge frame and 20 gauge blade. Blade shall be secured to 3/8 inch square or 1/2 inch diameter galvanized or plated axle/shaft that extends beyond frame through bearings and locking hand quadrant.

3. Dampers shall include permanently lubricated oilite bronze bearings pressed securely into damper frame.

4. Dampers shall include factory furnished locking quadrants with 2 inches elevated dial and "OPEN" and "CLOSED" indicators.

B. Manufacturer: Subject to compliance with requirements, provide balancing dampers of one of the following or approved equivalent: (See Table A at the end of Section)

2.2 DYNAMIC CLOSURE FIRE DAMPERS

A. Dynamic Fire Dampers: Provide fire dampers of the dynamic closure type where indicated. Construct casings of minimum 22 gage galvanized steel with mil finish. Provide fusible link rated at 160 to 165 degrees F (71 to 74 degrees C) unless otherwise indicated. Dampers in high velocity ducts shall be designed for high velocity duct installation. Provide damper with positive lock in closed position, and with the following additional features:

1. Provide a factory installed galvanized steel sleeve for each fire damper as required by the UL listing of the damper. The minimum sleeve thickness and length shall be determined in accordance with the UL listing for the damper size, duct connection type and wall thickness.

2. UL Listing: Fire dampers shall be UL listed and labeled.

3. Damper Blade Assembly: Curtain type, clear of air stream.


5. Provide a hinged access panel for each fire damper. Access panel size shall be 18 inch x 20 inch for ducts 22 inches wide and larger. For duct width less than 22 inches, panel size shall be 18 inch x (duct width minus 2 inches). Locate access panels where door can be fully opened to access and service fire damper. Provide one access panel for each 36 inches of damper width. Provide label for each access panel entitled "FIRE DAMPER" in 1 inch high red letters located on face of door.

6. Manufacturer: Subject to compliance with requirements, provide fire dampers of one of the following or approved equivalent:
7. Ruskin, Model DIBD2.
8. NCA Manufacturing, Inc., Model DFD.
9. Greenheck, Model DFD.
10. Air Balance, Inc., Model D19B.
11. Pottorf, Model VFD.

2.3 CEILING FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements provide ceiling fire dampers with one of the following or approved equivalent:

1. Pottorf, CFD-521-BT.

B. General Description: Labeled according to UL 555C; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

D. Blades: Galvanized sheet steel with refractory insulation.

E. Fusible Links: Replaceable 165 degrees F (74 degrees C) rated.

2.4 TURNING VANES

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards."

2.5 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
2. Quadrant Locks: Provide quadrant lock device on one end of shaft and end bearing plate on other end for damper lengths over 12 inches. Provide 2 inches extended quadrant locks and 2 inches end extended bearing plates for externally insulated ductwork.
3. Duro-dyne, Model 8021.
4. Young, Model 443B/404B.
5. Concealed dampers that are not accessible shall be controlled by a concealed regulator, type as indicated. Where type is not indicated, provide type as recommended by manufacturer for application. Include flush chrome plated access panel for each.
6. Duro-dyne, Model 8009.
7. Young, Model 301/315.
8. Spin-In Fittings:
10. Sheet Metal Connectors, Inc., Model G.
12. High Efficiency Takeoffs (Rectangular Tap with Transition to Round Branch):
13. Sheet Metal Connectors, Inc., Model HET (24 gage.).
14. Field fabricated as detailed on the drawings.
15. Dace, Model STO.

2.6 DUCT ACCESS DOORS

A. General: Provide where indicated, duct access doors of size indicated.

B. Construction: Construct of same or greater gage as ductwork served; provide insulated doors for insulated ductwork with minimum 1 inch insulation (k-value = 0.26 at 75 degrees F mean temperature sandwiched between sheetmetal panels. Provide flush frames for uninsulated ductwork; extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12 inches high and smaller, 2 handle-type latches for larger doors. Screwdriver operated latches are not acceptable.

2.7 FLEXIBLE CONNECTIONS

A. Provide flexible duct connections wherever ductwork connects to HVAC equipment, fans or other vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

2.8 FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Hart & Cooley, Inc.
4. Thermaflex.
5. Peppertree Air Solutions.

B. Insulated-Duct Connectors: UL 181, Class 1, liner of multiple layers of aluminum laminate supported by helically wound, galvanized or coated 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. Rated Air Velocity: 4000 fpm (20.3 m/s).
3. Temperature Range: Minus 20 to plus 210 degrees F (Minus 28 to plus 99 degrees C).
5. Smoke Developed: Less than 50.
6. Thermal Conductance: C Factor not more than 0.23.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes to suit duct size.
PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Where ducts take off mains, and where ducts divide, install splitter dampers or volume dampers, each with adjustable locking quadrant control. Provide volume damper unless splitter damper is indicated. Provide adjustable pivoting splitter with locking quadrant control for all splitter dampers. Provide a volume damper after each splitter damper, located in the branch with the lowest resistance.

C. Concealed dampers that are not accessible shall be controlled by a concealed regulator, type as indicated. Where type is not indicated, provide type as recommended by manufacturer for application. Include flush chrome plated access panel for each.

D. Install turning vanes in all square or rectangular 90° elbows in supply, return, and exhaust air systems, and elsewhere as indicated.

E. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

F. Install flexible ducts only where indicated and only in extended straight lengths not to exceed 36 inches; bend, sags, or elbows will not be permitted.

G. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers, and adjust for proper action.
B. Final positioning of manual dampers is specified in Division 23 Section 23 05 93, "Testing, Adjusting, and Balancing."

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

### TABLE A

<table>
<thead>
<tr>
<th></th>
<th>Single Blade</th>
<th>Opposed Blade</th>
<th>Parallel Blade</th>
<th>Round Blade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ruskin</td>
<td>MD35</td>
<td>MD35</td>
<td>MD35</td>
<td>MDRS25</td>
</tr>
<tr>
<td>2. Air Balance, Inc.</td>
<td>AC-1</td>
<td>AC-2</td>
<td>AC-1</td>
<td>AC-530</td>
</tr>
<tr>
<td>4. American Warming and Ventilating</td>
<td>VC-1</td>
<td>VC-2</td>
<td>VC-2</td>
<td>VC-25</td>
</tr>
<tr>
<td>5. Safe-Air</td>
<td>612</td>
<td>610</td>
<td>611</td>
<td>BDR</td>
</tr>
<tr>
<td>6. Pottorf</td>
<td>CD10</td>
<td>CD425</td>
<td>CD10</td>
<td>CD10R</td>
</tr>
<tr>
<td>7. Dace Mtg</td>
<td>MBD</td>
<td>MDB</td>
<td>---</td>
<td>----</td>
</tr>
<tr>
<td>8. Nailor</td>
<td>1870</td>
<td>1820</td>
<td>1810</td>
<td>1890</td>
</tr>
</tbody>
</table>

END OF SECTION 23 30 00
SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 1- to plus 2-inch wg (minus 500 to plus 2500 Pa). Metal ducts include the following:

1. Single-wall rectangular ducts and fittings.
2. Single-wall, round, longitudinal seams and fittings.
3. Single-wall round spiral seam ducts and formed fittings
4. Double-wall round spiral seam ducts and formed fittings

B. Related Sections include the following:

1. Division 23 Section 23 33 00, "Ductwork Accessories," for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.4 QUALITY ASSURANCE


B. Codes and Standards:

1. SMACNA Standards: "HVAC Duct Construction Standards, Metal and Flexible."
2. International Mechanical Code.

C. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."


PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phoshatized finish for surfaces exposed to view.

C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Stainless Steel: ASTM A 480/A 480M, Type 304, and having a No. 2D finish for concealed ducts and No. 7 for exposed ducts.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

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).

2.2 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.

C. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

D. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.


2.4 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, joints, transitions, offsets, branch connections, and other construction according to SMACNA's, "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

2.5 ROUND DUCT AND FITTING FABRICATION

A. Round, Longitudinal-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's, "HVAC Duct Construction Standards--Metal and Flexible."

B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

1. Manufacturers:
   a. McGill AirFlow Corporation
b. SEMCO Incorporated  
c. Graco  
d. Mason Road Sheet Metal  
e. Hamlin Sheet Metal  
f. Spiral Pipe of Texas  
g. Eastern Sheet Metal  
h. Duct Direct

2. Duct Joints:

a. Ducts up to 20 Inches (500 mm) in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.  
b. Ducts 21 to 72 Inches (535 to 1830 mm) in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.  
c. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

3. Manufacturers:

a. Ductmate Industries, Inc.  
b. Lindab Inc.

4. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

5. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

6. Fabricate elbows using die-formed or mitered construction. Bend radius of die-formed shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

a. Mitered-Elbow Radius and Number of Pieces: Continuously welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

b. Round Mitered Elbows: Continuously welded construction with the following metal thickness for pressure classes from minus 2 to plus 2 inch wg (minus 500 to plus 500 Pa):

1) Ducts 3 to 36 Inches (75 to 915 mm) in Diameter: 0.034 inch (0.85 mm).
   a. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2 to 10 inch wg (500 to 2500 Pa):
      1. Ducts 3 to 26 Inches (75 to 660 mm) in Diameter: 0.034 inch (0.85 mm).
      2. Ducts 27 to 50 Inches (685 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
   b. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45 and 90 degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate
nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

c. Round Elbows Larger than 9 Inches in Diameter: Fabricate mitered elbows for 30, 45, 60, and 90 degrees.

d. Die-Formed Elbows for Sizes through 8 Inches (200 mm) in Diameter and All Pressures 0.040 inch (1.0 mm) thick with 2-piece welded construction."

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts: 4-inch wg (1 Kpa).

B. All ducts shall be galvanized steel.

C. Round ducts 10” diameter and smaller - longitudinal seam.

D. Round ducts 12” diameter and larger - spiral seam with formed fittings.

E. Sound Attenuating ducts – Double wall spiral seam with perforated inner metal layer. Liner shall have coating rated for minimum velocity of 5000 ft/min and R-value as required by ASHRAE 90.1.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's, "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round ducts in lengths not less than 12 feet (3.7 meters) unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections. Branch duct connections "tapped" into round mains will not be acceptable.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs unless indicated on the Drawings.
G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a minimum clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures. Route ducts to avoid passing over electrical panelboards and switchboards.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section 23 33 00, "Ductwork Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

O. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."
   1. Follow SMACNA “Duct Cleanliness for New Construction Guidelines” Utilize requirements for ADVANCED level or clean ALL new duct systems and equipment in accordance with paragraph 3.7 of this section and Section 23 01 30 HVAC Air-Distribution System Cleaning included in this addenda.

P. All branch connections shall be provided with a volume control damper. Provide opposed blade or splitter damper as indicated at each branch duct connection for supply air, return air, outside air, and exhaust air. Provide opposed blade damper where damper is not indicated.

3.3 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's, "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
   1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.

B. Seal ducts before external insulation is applied.
3.4 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet (5 meters) and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section 23 33 00, "Ductwork Accessories."

B. Comply with SMACNA's, "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's, "HVAC Air Duct Leakage Test Manual" and prepare test reports:
   1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
   3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg (500 to 2500 Pa).
   4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.7 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.
1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems 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.
   5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.

E. 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. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:
   1. Visually inspect metal ducts for contaminants.
   2. Where contaminants are discovered, re-clean and re-inspect ducts.

END OF SECTION 23 31 13
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 SUBMITTALS
A. Product Data: For each product indicated, include the following:
   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, Register, and Grille Schedule: Indicate model number and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. The following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide one of the products scheduled on the drawings.

2.2 SOURCE QUALITY CONTROL
A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas where diffusers, registers, and grilles are to be 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.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles 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 practicable. 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, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13
PART 1 - GENERAL

Related Documents
A. Variable Refrigerant Volume Split System Heat Pumps
C. Multi Evaporator DX Split System Indoor Units.

1.01. Physical characteristics
A. General:
The advanced multi-zone controller shall be made from plastic materials with a neutral color. Each control shall have a LCD (Liquid Crystal Display) that shows On/Off, setpoint, room temperature, mode of operation (Cool/Heat/Dry/Fan/Auto), louver position, and fan speed.

1.02. Electrical characteristics
A. General:
The advanced multi-zone controller will require 24 VAC to power the controller. The advanced multi-zone controller shall supply 16 VDC to the communication bus on the control terminal of the outdoor unit. The voltage may rise or fall in relation to the transmission packets that are sent and received.

B. Wiring:
The advanced multi-zone controller communication wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to branch selector then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit. The termination of the wiring shall be non-polar. The remote control wiring shall run from the indoor unit control terminal block to the remote controller connected with that indoor unit.

C. Wiring size:
Wiring shall be non-shielded, 2-conductor sheathed vinyl cord or cable, and 18 AWG stranded copper wire.

1.03. VRV Controls Network
The VRV Controls Network is made up of local remote controllers, multi-zone controllers, advanced multi-zone controllers, and open protocol network devices that transmit information via the communication bus. The VRV Controls Network shall also have the ability to be accessed via a networked PC. The VRV Controls Network supports operation monitoring, scheduling, error e-mail distribution, general user software, tenant billing, maintenance support, and integration with Building Management and Control Systems (BMCS) using open protocol via BACnet® interface.

PART 2 - PRODUCTS

2.01. All products shall be provided by the same manufacturer as the equipment furnished in related sections above.

2.02. Advanced Multi-zone Controllers
The advanced multi-zone controllers shall be compatible with all VRV indoor units and outdoor units. The advanced multi-zone controller wiring shall consist of a non-polar two-wire connection to the outdoor unit. The advanced multi-zone controllers may be wall-mounted and can be adjusted to maintain the optimal operation of up to 64 connected indoor unit groups and 128 indoor units. Set temperatures can be adjusted...
in increments of 1°F. In the cases where a system or unit error may occur, the VRV controllers will display a two-digit error code and the unit address.

A. Touch Manager
The Touch Manager shall provide control for all VRV indoor units. It shall be capable of controlling a maximum or 64 indoor unit groups and 128 indoor units connected to a maximum of 10 outdoor units. Touch Manager shall support operations superseding that of the local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.

The controller wiring shall consist of a non-polar two-wire connection to the indoor units of the outdoor units. The intelligent Touch Manager is wall mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s).

Touch Manager can be used in conjunction with BACnet interface to control the same indoor unit groups. The remote controller shall require daisy chain wiring for grouping multiple indoor units (up to 16) together. Manual addressing is required of each remote controller group associated with the Touch Manager.

The Touch Manager shall be equipped with two RJ-45 Ethernet ports for 100 Mbps network communication to support interconnection with a network PC via the Internet, Local Area Network (LAN), or connection with a non-networked PC after completed installation.

Web access functions shall be available so that facility staff can securely log into each Touch Manager via the PC’s web browser to support monitoring, scheduling, error recognition, downloading of system operation data (trend log (refer to pints list under BACnet server)) and general user functions. Error emails are also sent to designated email addresses. An additional optional software function Power Proportional Distribution (PPD) tenant billing shall also be available. The optional software shall require advanced purchase and can only be activated upon receipt of a license activation key from Daikin AC.

1. Mounting:
The Touch Manager shall be mounted on the wall or into the mounting fixtures included with the Touch Manager.
2. Display Features:
a. The Touch Manager shall be approximately 11.42” x 9.57” x 1.97’ in size with a backlit 10.4” LCD display.
b. Display information shall be selectable from English or Spanish.
c. Featured backlit LCD with auto off after 30 minutes (default) is adjustable between 1 to 60 minutes, or the choice of 3 different screen savers.
d. The Controller shall display On/Off, Operation Mode, Setpoint, Space Temperature, Louver Position, Fan Speed for each unit.
e. The Controller shall display Date (mm/dd/yyyy, yyyy/mm/dd, or dd/mm/yyyy format selectable) and day of the week along with the time of day (12hr or 24hr display selectable).
f. The Controller shall adjust for daylight savings time (DST) automatically.
g. Display information shall be updated every 3 seconds to show the latest status of the indoor unit groups.
h. System status icons shall display On/Off (color coded), Malfunction/Error (color coded), Forced Stop, Setback, Filter, Maintenance, and Screen Lock.
i. The controller shall display the temperature setpoint in one degree increments with a range of 60°F – 90°F, 1°F basis (16°C – 32°C, 0.1°C basis).
j. Display of temperature setpoint information shall be configurable for Fahrenheit or Celsius.
1) Display of temperature setpoint information shall be configurable for Fahrenheit or Celsius.

1) Display of room temperature information shall be configurable for Fahrenheit or Celsius.
k. The Menu List shall be used to configure options and display information for each Area or Group.

l. Error status shall be displayed in the event of system abnormality/error with one of three color coded icons placed over the indoor unit icon or lower task bar.

1) System errors are generated when the Touch Manager system with other VRV controls systems are combined incorrectly or power proportional distribution calculation errors occur. The intelligent Touch Manager shall display the error with a red triangle placed on the lower task bar.

2) Unit errors occurring within the VRV system shall be displayed with a yellow triangle placed over the indoor unit icon

3) Limit errors are based upon preconfigured analog input upper and lower limit settings and are generated when the limits have been met. When limit error is generated a yellow triangle will be placed over the unit icon.

4) Communication errors between the Touch Manager and the indoor units shall be displayed with a blue triangle placed over the indoor unit icon

5) Error history shall be available for viewing for up to 500,000 errors/abnormality events with operation events.

m. Layout View

1) Shall display site floor plan or graphical user interface (GUI) as the background for visual navigation. Outdoor and Indoor units, icons with operational status can be placed on the floor layout or GUI

i) Up to 4 status points can be assigned to the indoor unit icon (room name, room temperature, setpoint, and mode)

ii) Digital input and output icons will display On/Off status

3. Basic Operation:

a. Capable of controlling by Area(s) or Group(s)

b. Controller shall control the following group operations:

1) On/Off

2) Operation Mode (Cool, Heat, Fan, Dry, and Auto)

3) Independent Cool and Heat dual Setpoints or single Setpoint for current mode in the occupied period

4) Controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating based upon the Area or Group configurations

5) Independent Setup (Cooling) and Setback (Heating) setpoints in the unoccupied mode adjustable to 50 - 95°F

i) Setup and Setback setpoints can only be set outside of the occupied setpoint range

ii) The Setup and Setback setpoints will automatically maintain a 2°F fixed differential from the highest possible occupied setpoints

iii) The recovery differential shall be 4°F (default) and adjustable between 2 – 10°F

iv) Settings shall be applied based upon the Area or Group configurations

6) Fan Speed

i) Up to 3 speeds (dependent upon indoor unit type)

7) Airflow direction (dependent upon indoor unit type)

i) 5 fixed positions or oscillating

8) Remote controller permit/prohibit of On/Off, Mode, and Setpoint

9) Lock out setting for Intelligent Touch Manager display

10) Indoor unit Group/Area assignment

c. Capable of providing battery backup power for the clock at least 1 year when no AC power is applied.

1) The battery can last at least 13 years when AC power is applied

2) Settings stored in non-volatile memory
4. Programmability:
   a. Controller shall support weekly schedule settings.
   1) 7 day weekly pattern (7)
   2) Weekday + Weekend (5 + 2)
   3) Weekday + Saturday + Sunday (5 + 1 + 1)
   4) Everyday (1)
   5) The schedule shall have the capabilities of being enabled or disabled
   6) 100 independent schedules configurable with up to 20 events settable for each days schedule
      i) Each scheduled event shall specify time and target Area or Group
      ii) Each scheduled event shall include On/Off, Optimum Start, Operation Mode, Occupied Setpoints, Setback Setpoints, Remote Controller On/Off Prohibit, Remote Controller Mode Prohibit, Remote Controller Setpoint Prohibit, Timer Extension Setting, Fan Speed, and Setpoint Range Limit
      • Setpoint when unit is On (occupied)
      • Configurable Setup (Cooling) and Setback (Heating) setpoints when unit is Off (unoccupied)
      iii) Time setting in 1-minute increments
      iv) Timer Extension shall be used for a timed override (settable from 30 – 180 minutes) to allow indoor unit operation during the unoccupied period
   7) A maximum of 40 exception days can be schedule on the yearly schedule (repeats yearly)
      i) Exception days shall be used to override specified days on the weekly schedule based upon irregular occupied/unoccupied conditions
      ii) Exception days can be configured on a set date (Jan 1) or floating date (1st Monday in September)
   b. Controller shall support auto-changeover.
   1) Auto-change shall provide Fixed (default), Individual, Averaging, and Vote changeover methods for both Heat Pump and Heat Recovery systems based upon the changeover group configuration. This will allow for the optimal room temperature to be maintained by automatically switching the indoor unit’s mode between Cool and Heat in accordance with the room temperature and setpoint. The following changeover scheme shall be applicable to the Fixed, Individual, and Averaging methods.
      i) Changeover to cooling mode shall occur at cooling setpoint + 1°F (0.5°C) as the primary changeover deadband and takes the guard timer into consideration
         • Configurable from 1 – 4°F (0.5 – 2°C)
      ii) Changeover to cooling mode shall occur at the primary changeover deadband to cooling + 1°F (0.5°C) as the secondary changeover deadband.
         • Configurable from 1 – 4°F (0.5 – 2°C)
      iii) Changeover to heating mode shall occur at heating setpoint - 1°F (0.5°C) as the primary changeover deadband and takes the guard timer into consideration
         • Configurable from 1 – 4°F (0.5 – 2°C)
      iv) Changeover to heating mode shall occur at the primary changeover deadband to heating - 1°F (0.5°C) as the secondary changeover deadband.
         • Configurable from 1 – 4°F (0.5 – 2°C)
      v) A weighted demand shall be configurable for the Averaging and Vote methods.
   2) Fixed Method
      i) Changeover evaluated by room temperature and setpoint of the representative indoor unit (first registered indoor unit in changeover group) in the changeover group even when it is not operating (must be in Cool, Heat, or Auto mode)
      ii) Changeover affects all indoor unit groups in the changeover group.
3) Individual method (recommended for Heat Recovery Systems)
   i) Changeover evaluated by room temperature and setpoints of the individual indoor unit group in the changeover group
   ii) Changeover affects individual indoor unit group in the changeover group

4) Average method
   i) Changeover evaluated by the average of all indoor unit group’s room temperatures and setpoints operating in Cool, Heat, or Auto mode in the changeover group list
   ii) If none of the indoor units in the group meet the above requirements the Fixed method of changeover will be applied
   iii) A weighted demand (0 – 3) can be configured for each indoor unit in the changeover group.
   iv) Changeover affects all indoor unit groups in the changeover group.

5) Vote Method
   i) In each indoor unit, the cooling demand is calculated based upon the difference between the room temperature and cooling setpoint. If the room temperature falls below the primary cool changeover point (cool setpoint plus the primary changeover deadband) the cooling demand is considered as 0 (zero). Then the total cooling demand is calculated as the sum of each indoor unit’s cooling demand
   ii) The opposite is true for the total heating demand
   iii) A weight (0-3) can be added to each indoor unit’s demand in the changeover group. The default setting is 1
   iv) The weight 0 (zero) means the indoor unit’s demand is not added in the total demand, so the indoor unit’s demand is considered to be 0 (zero)
   v) The weight 2 or 3 means the indoor unit’s demand is added 2 or 3 times in the total demand, respectively
   vi) Changeover to cooling mode shall occur when the total cooling demand is greater than the total heating demand.
   vii) The opposite is true for changeover to heating
   viii) Vote supports a Heating Override option, which prioritizes switching to the heating mode if at least one room temperature falls below the secondary heat changeover point (heat setpoint minus the secondary changeover deadband) even if the total cooling demand is greater than the total heating demand.
   ix) Changeover affects all indoor unit groups in the changeover group.

6) Changeover shall change the operation mode of the indoor unit that is set as the Changeover Master. The Changeover Master indoor unit shall then change the operation mode of all indoor unit groups daisy chained to the same outdoor unit in the Heat Pump system or branch selector box in the Heat Recovery system.

7) Guard timer
   i) Upon changeover, guard timer will prevent another changeover during the guard timer activation period (15, 30, 60 (default) min).
   ii) Guard timer is ignored by a change of setpoint manually from either intelligent Touch Manager or Remote Controller, by schedule, or the room temperature meets or exceeds the secondary changeover deadband of the mode opposite of the current mode setting

C. Controller shall support Interlock
   1) Interlock feature for use with 3rd party equipment (DOAS, dampers, occupancy sensing, etc…) to automatically control Groups or Areas corresponding to the change of the operation states or the On/Off states of any Group.
   2) WAGO I/O unit – Di, Do, Ai, Ao
   i) On/Off based monitoring and control of equipment
   ii) Manual or scheduled operation of equipment
   iii) Operation based upon interlock with management points (group(s))
   iv) Monitor equipment error/alarm status
v) WAGO I/O operation data for every minute in the last 5 days are stored and can be downloaded from Web access or USB

3) Digital Input/Output unit or Digital Input unit
i) On/Off based monitoring and control of equipment
ii) Manual or scheduled operation of equipment
iii) Operation based upon interlock with management points (group(s))
iv) Monitor equipment error/alarm status
d) Controller shall support force shutdown of associated indoor unit groups.

5. Web/Email Function
a. Each Touch Manager (TM) shall be capable of monitoring, operating, and scheduling a maximum of 64 indoor unit groups from a networked PC’s web browser. It shall also be capable of creating general user access and sending detailed error emails to a customized distribution list (up to 10 email addresses).
b. All PCs shall be field supplied
c. The following operation data stored every minute for the last 5 days can be accessed and downloaded through TM web function:
   1) Indoor and outdoor unit (applied model only) operation data.
   2) BACnet Client management data points (AI, AO, AV, BI, BO, BV, MI, MO and MV).
   3) WAGO IO system data points (External DI, DIO, PI, AI and AO).

6. Operational Data History
a. Operation data are stored in the TM every minute for the last 5 days:
   1) VRV indoor and outdoor unit (if supported) operation data.
   2) BACnet Client management data points (AI, AO, AV, BI, BO, BV, MI, MO and MV).
   3) WAGO IO system data points (External DI, DIO, PI, AI and AO).
b. The operation data can be exported through the TM web function or USB output with a user specified time period.
c. Airnet addressing required for both indoor units and outdoor units to enable the operation data on the TM.
SECTION 23 81 25 - VARIABLE REFRIGERANT VOLUME HVAC SPLIT SYSTEM (HEAT PUMP)

GENERAL

1.01 SECTION INCLUDES

A. Variable refrigerant volume HVAC system includes:

   1. Outdoor/Condensing unit(s):

      a. Size Range: 6 to 34 Tons Nominal

1.02 RELATED DOCUMENTS

A. Section 23 81 00 Variable Refrigerant Volume HVAC System Controller

B. Section 23 81 30 Multi Evaporator DX Split System Indoor Units

1.03 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each central-station air-handling unit specified, including the following:

   1. Certified fan-performance curves with system operating conditions indicated.
   2. Certified fan-sound power ratings.
   3. Certified coil-performance ratings with system operating conditions indicated.
   4. Motor ratings and electrical characteristics plus motor and fan accessories.
   5. Material gages and finishes.
   6. Dampers, including housings.

C. Shop Drawings from Manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Field test reports indicating and interpreting test results relative to compliance with specified requirements.
E. Maintenance data for central-station air-handling units to include in the operation and maintenance manual specified in Division 1 Sections.

1.04 QUALITY ASSURANCE

A. MANUFACTURER QUALIFICATIONS:

1. The units shall be tested by a National Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.

2. All wiring shall be in accordance with the National Electric Code (NEC).

3. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

4. The condensing unit will be factory charged with R410A.

1.05 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer’s recommendations.

1.06 WARRANTY

A. The units shall have a manufacturer parts and contractor labor warranty for a period of one (1) year from date of Substantial Completion. Units and components shall be covered by the manufacturer’s limited warranty for a period of five (5) years from date of installation. The compressors shall have a warranty of seven (7) years from date of installation.

PRODUCTS

2.01 MANUFACTURERS

A. DESIGN BASIS:

1. The HVAC equipment basis of design is Daikin North America. All bidders shall furnish the minimum system standards as defined by the base bid model numbers, model families or as otherwise specified herein. The contractor shall be responsible for all specified items and intents of this document without further compensation.

B. ALTERATE MANUFACTURERS
1. LG, ARUM Series

2. Mitsubishi, TUHYP Series

2.02 HVAC SYSTEM DESIGN

A. SYSTEM DESCRIPTION:

1. The system shall consist of multiple evaporators using PID control, REFNET™ joints and headers, a two-pipe refrigeration distribution system and condenser unit.

2. The condenser shall be a direct expansion (DX), air-cooled heat pump, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant.

3. The condensing unit may connect an indoor evaporator capacity up to 200% of the condensing unit capacity. All zones are each capable of operating separately with individual temperature control.

4. The condensing unit shall be interconnected to indoor units in accordance with the manufacturers recommended practices.
   
   a. The indoor units shall be connected to the condensing unit utilizing Daikin’s REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.

5. Operation of the system shall permit either cooling or heating of all of the indoor units simultaneously. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Manager, an Intelligent Controller or a BMS interface.

B. VRV IV FEATURES

1. Voltage Platform - Heat pump condensing units shall be available with a 460V/3ph/60Hz power supply.

2. Advanced Zoning - A single system shall provide for up to 64 zones.

3. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve with 2000 positions for independent control.

4. VFD Inverter Control and Variable Refrigerant Temperature - Each condensing unit shall use high efficiency, variable speed all “inverter” compressor(s) coupled with inverter
fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions.

a. Indoor shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.

5. Configurator software - Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes.

6. Autocharging - Each system shall have a refrigerant auto-charging function.

7. Flexible Design –

a. Systems shall be capable of up to 540ft (165m) [623 ft. (190m) equivalent] of linear piping between the condensing unit and furthest located indoor unit.

b. Systems shall be capable of up to 3,280ft (1,000m) total “one-way” piping in the piping network.

c. Systems shall have a vertical (height) separation of up to 295ft (90m) between the condensing unit and the indoor units.

d. Systems shall be capable of up to 295ft from the first REFNET™ / branch point.

e. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit nominal capacity.

f. Systems shall be capable of 98ft (30m) vertical separation between indoor units.

g. Condensing units shall be supported with a fan motor ESP up to 0.32” WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.

8. Oil Return – Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle.

9. Simple wiring – Systems shall use 16/18 AWG, 2 wire, stranded, non-shielded and non-polarized daisy chain control wiring.
10. Advanced diagnostics – Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.

11. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.

12. Advanced controls – Each system shall have at least one remote controller capable of controlling up to 16 indoor units.

13. Each system shall be capable of integrating with open protocol BACnet and LonWorks building management systems.

14. Low sound levels - Each system shall use indoor and condensing units with quiet operation as low as 27 dB(A).

C. PERFORMANCE:

1. The system shall have the performance capacity as scheduled on the drawings.

2. Cooling Operation:
   a. The operating range in cooling will be 23°F DB ~ 122°F DB (-5°CDB ~ 50°CDB).
   b. Cooling mode indoor room temperature range will be 57-77°FWB (13.8 - 25°CWB).
   c. Cooling operation may be extended down to 10°F DB.

3. Heating Operation:
   a. The operating range in heating will be -4°F WB – 60°F WB (-20°CWB – 15.5°CWB).
   b. Heating mode indoor room temperature range will be 59°FDB - 80°F DB (15°CDB – 26.7°CDB).

2.03 EQUIPMENT

A. ELECTRICAL:
1. The power supply to the condensing unit shall be as indicated on the drawings.

B. WIRING:

1. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.

2. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.

3. The control wiring maximum lengths shall be as shown below as recommended by the equipment manufacturer.

C. REFRIGERANT PIPING:

1. The system shall be capable of refrigerant piping up to 540ft (165m) actual or 623ft (190m) equivalent from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280ft (1,000m) of piping between the condensing and indoor units with 295ft (90m) maximum vertical difference, without any oil traps or additional components.

2. REFRNET™ piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance.
   a. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

D. PAINT/CORROSION RESISTANCE:

1. Paint and corrosion resistance shall be at a minimum per the table A. at the end of this section.

2.04 OUTDOOR/CONDENSING UNIT

A. GENERAL:

1. The condensing unit is designed specifically for use with VRV series components.

2. The condensing unit shall be factory assembled in the USA and pre-wired with all necessary electronic and refrigerant controls.

3. The refrigeration circuit of the condensing unit shall consist of inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way
valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant accumulator.

4. Liquid and suction lines must be individually insulated between the condensing and indoor units.

5. The condensing unit can be wired and piped with access from the left, right, rear or bottom.

6. The connection ratio of indoor units to condensing unit shall be permitted up to 200% of nominal capacity.

7. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.

8. The sound pressure level standard shall be that value as listed in the Manufacturer’s engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night time or via an external input.

9. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.

10. The unit shall incorporate an auto-charging feature to ensure optimum performance. Manual changing should be support with a minimum of 2 hours of system operation data to ensure correct operation.

11. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.

12. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.

13. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.

14. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.
15. The condensing unit shall be capable of heating operation at 0°F (-18°C) dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.

B. UNIT CABINET:

1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel finish.

C. FAN:

1. The condensing unit shall consist of one or more propeller type, direct-drive 500 or 600 W fan motors that have multiple speed operation via a DC (digitally commutating) inverter.

2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.

3. The fan shall be a vertical discharge configuration.

4. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.

5. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

D. CONDENSER COIL:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.

2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.

3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.

4. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM test standards.

SPLIT SYSTEM HEAT PUMP
Guth PN 6914 23 81 25 - 8
5. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during heating operation enhancing the defrost operation.

   a. An alternate manufacturer must provide a drain pan heater to enable adequate defrosting of the unit in defrost operation.

6. The condensing unit shall be factory equipped with condenser coil guards on all sides.

E. COMPRESSOR:

1. The inverter scroll compressors shall be variable speed to change the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.

   a. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value.

   1) Non–inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.

   2. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “G-type” or “J-type”.

   3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type.

      a. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.

   4. The capacity control range shall be as low as 10% to 100%.

   5. The compressor’s motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.

   6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.

8. The compressor shall be spring mounted to avoid the transmission of vibration eliminating the standard need for spring insolation.

9. In the event of compressor failure, the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifolded systems.

10. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system sequential start is activated for all system on each network.

2.05 INDOOR/EVAPOTATOR UNITS
   A. Refer to Section Multi Evaporated DX Split System Indoor Units

EXECUTION

3.1 INSTALLATION
   A. Install units level and plumb.
   B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
   C. Install ground-mounting, compressor-condenser components on polyethylene mounting base.
   D. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
   E. Provide spare washable filters in addition to the initial set for each unit.
      1. 3’ x 3’ size – 20 filters.
      2. 2’ x 2’ size – 10 filters.
3.2 CONNECTIONS
   A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
   B. Install piping adjacent to unit to allow service and maintenance.
   C. Ground equipment according to Division 26 Section "Grounding and Bonding."
   D. Electrical Connections: Comply with requirements in Division 16 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL
   A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
   B. Perform the following field tests and inspections and prepare test reports:
      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.

3.4 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.

3.5 DEMONSTRATION
   A. Train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 1.
<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>BASE MATERIAL</th>
<th>SURFACE TREATMENT</th>
<th>COATING THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTERNAL PANEL BASE</td>
<td>Galvanized steel</td>
<td>POLYESTER</td>
<td>≧1.5 mils</td>
</tr>
<tr>
<td>EXTERNAL FRONT PANEL</td>
<td>Galvanized steel</td>
<td>POLYESTER</td>
<td>≧1.5 mils</td>
</tr>
<tr>
<td>PILLAR</td>
<td>Galvanized steel</td>
<td>POLYESTER</td>
<td>≧1.5 mils</td>
</tr>
<tr>
<td>COMPRESSOR COVER</td>
<td>ASTM material</td>
<td>Resin Paint</td>
<td>≧0.78 mils</td>
</tr>
<tr>
<td>FIN GUARD</td>
<td>Iron wire</td>
<td>Resin Paint</td>
<td>≧0.79 mils</td>
</tr>
<tr>
<td>FAN GUARD AND DRUM</td>
<td>Polypropylene</td>
<td>No treatment required</td>
<td>N/A</td>
</tr>
<tr>
<td>FAN</td>
<td>Acrylonitrile - glass</td>
<td>No treatment required</td>
<td>N/A</td>
</tr>
<tr>
<td>FAN MOTOR FRAME</td>
<td>Resin</td>
<td>No treatment required</td>
<td>N/A</td>
</tr>
<tr>
<td>FAN MOTOR SHAFT</td>
<td>Carbon steel</td>
<td>No treatment required</td>
<td>N/A</td>
</tr>
<tr>
<td>FAN MOTOR SUPPORT</td>
<td>Galvanized steel</td>
<td>POLYESTER</td>
<td>≧1.5 mils</td>
</tr>
<tr>
<td>HEAT EXCHANGERS (FIN ONLY)</td>
<td>Aluminum</td>
<td>Polymer Anti-corrosion surface treatment</td>
<td>Salt Spray 1000 hours, blister rating 10</td>
</tr>
<tr>
<td>COMPONENT</td>
<td>MATERIAL DESCRIPTION</td>
<td>TREATMENT</td>
<td>COMPLIANCE</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------------------------</td>
<td>----------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>ELECTRICAL PARTS BOX</td>
<td>Hot-dip zinc-coated steel</td>
<td>No treatment required</td>
<td>N/A</td>
</tr>
<tr>
<td>ELECTRICAL PARTS BOARD</td>
<td>Glass cloth / Glass nonwoven cloth material</td>
<td>Insulation Varnish</td>
<td>No specific thickness</td>
</tr>
<tr>
<td>SCREWS</td>
<td>Carbon steel wire rods</td>
<td>High corrosion resistance treatment</td>
<td>$\geq 0.28$ mils</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 23 81 30 - MULTI EVAPORATOR DX SPLIT SYSTEM INDOOR UNITS

GENERAL

SUMMARY

0.6 to 8 Tons Nominal

A. This Section includes the following indoor units:

1. ROUND FLOW SENSING CEILING CASSETTE UNIT
2. 4 WAY CEILING CASSETTE UNIT (2’x2’)
3. CONCEALED CEILING DUCTED UNIT (Med. Static)
4. SLIM DUCT CONCEALED CEILING UNIT
5. CEILING SUSPENDED CASSETTE UNIT
6. WALL MOUNTED UNIT
7. INDOOR AIR HANDLING UNIT 15-38 Nominal Tons

1.01 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995/CAN/CSA-C22.2 No. 236-05 (R2009) – Heating and Cooling Equipment and bear the Listed Mark.

B. All wiring shall be in accordance with the National Electric Code (NEC)/Canadian Electrical Code (CEC).

C. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

D. The outdoor unit will be factory charged with R-410A.

1.02 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer’s recommendations.

WARRANTY

STANDARD LIMITED WARRANTY

Manufacturer shall warrant that (the “Products”) will be free from defects in material and workmanship. The warranty applies to all parts and shall be ten (10) years starting from the “installation date” which is one of the two dates below:

The installation date is the date that the unit is originally commissioned, but no later than 18 months after the manufacture date noted on the unit’s rating plate.
a. If the date the unit is originally commissioned cannot be verified, the installation date is three months after the manufacture date.

PERFORMANCE

3.01 DESIGN BASIS

The HVAC equipment basis of design is Daikin. All bidders shall furnish the minimum system standards as defined by the base bid model numbers, model families or as otherwise specified herein. The contractor shall be responsible for all specified items and intents of this document without further compensation.

3.02 ALTERNATE MANUFACTURERS

Provide product meeting the requirements of the drawings and specifications by one of the following:

1. LG
2. Mitsubishi Electric

PRODUCTS

4.01 ROUND FLOW SENSING CEILING CASSETTE UNIT

A. General: Indoor unit shall be a round flow ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, direct drive DC (ECM) type fan, for installation into the ceiling cavity equipped with an air panel grill. Units to be connected to outdoor unit heat pump heat recovery model. It shall be a round flow air distribution type, fresh white, impact resistant decoration panel, or optional self-cleaning filter panel. The supply air is distributed via four individually motorized louvers. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. The indoor units sound pressure shall range from 30 dB(A) to 45 dB(A) at High speed measured at 5 feet below the unit.

B. Performance: Each unit’s performance shall be as scheduled on the drawings:

C. Indoor Unit:

1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

3. Both refrigerant lines shall be insulated from the outdoor unit.

4. The round flow supply air flow can be field modified to 23 different airflow patterns to accommodate various installation configurations including corner installations.

5. Return air shall be through the concentric panel, which includes a resin net, mold resistant, antibacterial filter.

6. The indoor units shall be equipped with a condensate pan with antibacterial treatment and condensate pump. The condensate pump provides up to 33-1/2” of lift from bottom of unit to top of drain piping and has a built in safety shutoff and alarm.

7. The indoor units shall be equipped with a return air thermistor.

8. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

9. The voltage range will be 253 volts maximum and 187 volts minimum.

10. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor.

11. Supplied air shall be directed automatically by four individually controlled louvers.

D. Unit Cabinet:

1. The cabinet shall be space saving and shall be located into the ceiling.

2. Four auto-adjusted louvers shall be available to choose, which include standard, draft prevention and ceiling stain prevention.

3. The airflow of the unit shall have the ability to shut down outlets with multiple patterns allowing for simpler installation in irregular spaces.

4. Fresh air intake shall be possible by way of fresh air intake kit.

5. A branch duct knockout shall exist for branch ducting of supply air.

6. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

7. Optional high efficiency air filters are available for each model unit.

E. Fan:
1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.

2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.08 to 0.16 HP.

3. The airflow rate shall be available in three manual settings.

4. The DC fan shall be able to automatically adjust the fan speed in 5 speeds based on the space load.

5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings to allow operation with the high efficiency air filter options.

6. The fan motor shall be thermally protected.

F. Filter:

1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin and antibacterial treatment.

2. Optional high efficiency disposable air filters shall be available.

3. Optional Self-Cleaning Filter Panel, which performs automatic filter cleaning up to once a day, with dust collection box that indicates when to be emptied.

G. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

3. The coil shall be a 2, or 3-row cross fin copper evaporator coil with up to 21 FPI design completely factory tested.

4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/4 inch outside diameter PVC.

5. A condensate pan with antibacterial treatment shall be located under the coil.

6. A thermistor will be located on the liquid and gas line.

H. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:

1. The unit shall have controls to perform input functions necessary to operate the system.

2. The unit shall be compatible with interfacing with a BMS system via BACnet gateway.

3. The unit shall be compatible with advanced multi-zone controller.

J. Optional Accessories Available:

1. A high efficiency disposable air filter kit

2. Air intake kit

3. Self-Cleaning Filter Panel, which performs automatic filter cleaning up to once a day, with dust collection box that indicates when to be emptied.

   a. Wall mounted, hard wired remote sensor kit.

4.02 2x2 CASSETTE UNIT

A. General: Indoor units shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with a decoration panel grille. Units shall be connected to outdoor unit heat pump or heat recovery outdoor unit. The decoration panel shall be a four-way air distribution type, with fresh white color, impact resistant with a washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. The indoor units sound pressure shall range from 25.5 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.

B. Indoor Unit:

1. The Daikin indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, flare connections, condensate drain pan, condensate drain pump,
condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

3. Both refrigerant lines shall be fully insulated from the outdoor unit or nearest branch connection into the refrigerant network.

4. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.

5. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.

6. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 24-13/16” of lift, measured from the drain outlet, and has a built in safety shutoff and alarm.

7. The indoor units shall be equipped with a return air thermistor.

8. The indoor unit will be powered with 208~230V/1-phase/60Hz.

9. The voltage range will be 253 volts maximum and 187 volts minimum.

C. Unit Cabinet:

1. The cabinet shall be space saving and shall be located into the ceiling.

2. Three auto-swing positions shall be available to choose from via field setting.

3. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.

4. Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet.

5. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

D. Optional Space and Presence sensor kit:

1. The space and presence sensor shall be color matched to the decoration panel.

2. The sensor kit shall be capable of sensing occupancy within the space and automatically controlling the indoor unit set point in response to the detection of occupancy.
3. The sensor kit shall be capable of automatically adjusting the direction of individual air discharge outlet louvers in response to the detection of occupants in the vicinity of the unit.

4. The sensor kit shall be capable of automatically adjusting the direction of individual air discharge outlet louvers in response to the sensed floor temperature.

E. Fan:

1. The fan shall be driven by a direct-drive DC motor with statically and dynamically balanced impeller and shall have three user-selectable speeds available: high, medium, and low.

2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output of 50W.

3. The airflow rate shall be available in high, medium, and low settings.

F. Filter:

1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

G. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

3. The coil shall be a 2-row cross fin copper evaporator coil with 22 FPI design completely factory tested.

4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/32 inch outside diameter PVC.

5. A condensate pan shall be located under the coil.

6. A condensate pump with a 24-13/16” lift, measured from the drain outlet, shall be located below the coil in the condensate pan with a built in safety alarm.

7. A thermistor will be located on the liquid and gas line.

H. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:

1. The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.

2. The unit shall be compatible with an advanced multi-zone controller.

J. Optional Accessories Available:

1. Space and Presence sensor kit
   a. Sensor kit shall be color matched to pair with the unit decoration panel.

2. Sealing member of air discharge outlet

3. Panel spacer
   a. Panel spacer shall be provided as required.

4. Direct fresh air intake kit.

5. Wired remote controller

6. Adaptor for wiring

7. Wiring adaptor for electrical appendices

8. Installation box for adaptor

   a. The wall mounted, hard wired remote sensor kit.

4.04 CONCEALED CEILING DUCTED UNIT (Med. Static)

A. General: Indoor unit, shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation into the ceiling cavity. It shall be constructed of galvanized steel casing. Indoor units shall be connected to outdoor unit heat pump or heat recovery model. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a
comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. The indoor units sound pressure shall be 48 dB(A) at low speed measured 5 feet below the ducted unit.

B. Performance: Each unit’s performance shall be as indicated on the drawings.

C. Indoor Unit:

1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an adjustable external static pressure switch.

2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

3. Both refrigerant lines shall be insulated from the outdoor unit.

4. The indoor units shall be equipped with a return air thermistor.

5. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

6. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:

1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.

2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:

1. The fan shall be direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.

2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz, with a motor output of 0.51 HP.

3. The airflow rate shall be available in high and low settings.

4. The fan motor shall be thermally protected.

5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
F. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

3. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.

4. The refrigerant connections shall be flare connections and the condensate will be 1-5/16 inch outside diameter PVC.

5. A thermistor will be located on the liquid and gas line.

G. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.

2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:

1. The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.

2. The unit shall be compatible with interfacing with a BMCS system via BACnet gateway.

3. The unit shall be compatible with an advanced multi-zone controller.

I. Accessories:

   a. Wall mounted, hard wired remote sensor kit.

4.07 FXDQ – SLIM DUCT CONCEALED CEILING UNIT

A. General: Indoor units shall be a Slim, built-in ceiling concealed fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity. The unit shall be constructed of a galvanized steel casing. Units shall be connected to outdoor unit heat pump or heat recovery model. It
shall be a horizontal discharge air with horizontal return air or bottom return air configuration. All models feature a very low height (7-7/8") making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. Included as standard equipment, a long-life filter that is mold resistant and a condensate drain pan and drain pump kit that pumps to 23-5/8" from the drain pipe opening. The indoor units sound pressure level shall range from 29 dB(A) to 32 dB(A) at low speed and 33 dB(A) to 36 dB(A) at high speed 5 feet below the suction grille.

B. Performance: Each unit’s performance shall be as indicated on the drawings.

C. Indoor Unit:

1. The indoor units shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have adjustable external static pressure capabilities.

2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

3. Both refrigerant lines shall be insulated from the outdoor unit.

4. Return air shall be through a resin net mold resistant filter.

5. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 23-5/8” of lift from the center of the drain outlet and has a built in safety shutoff and alarm.

6. The indoor units shall be equipped with a return air thermistor.

7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

8. The voltage range will be 253 volts maximum and 187 volts minimum.

9. Switch box shall be reached from the side or bottom for ease of service and maintenance.

D. Unit Cabinet:

1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:

1. The fan shall be direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.

2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 62W to 130W.

3. The airflow rate shall be available in high and low settings.

4. The fan motor shall be thermally protected.

5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.

F. Filter:

1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

G. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

3. The coil shall be a 2 or 3-row cross fin copper evaporator coil with 14 FPI design completely factory tested.

4. The refrigerant connections shall be flare connections and the condensate will be 1-1/32” outside diameter PVC.

5. A condensate pan shall be located under the coil.

6. A condensate pump with a 23-5/8” lift shall be located below the coil in the condensate pan with a built in safety alarm.

7. A thermistor will be located on the liquid and gas line.

H. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:

1. The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.

2. The unit shall be compatible with interfacing with a BMS system via BACnet gateway.

3. The unit shall be compatible with an advanced multi-zone controller.

J. Optional Accessories:

   a. The Wall mounted, hard wired remote sensor kit.

4.08 CEILING SUSPENDED CASSETTE UNIT

A. General: Indoor unit shall be a ceiling suspended fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall or ceiling within a conditioned space. Units shall be connected to outdoor unit heat pump or heat recovery model. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment. The indoor units sound pressure shall range from 32 dB(A) to 38 dB(A) at low speed measured at 3.3 feet below and from the unit.

B. Performance: Each unit’s performance shall be as scheduled on the drawings.

C. Indoor Unit:

1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation.
upon restart. The drain pipe can be fitted to from the rear, top or left and right sides of the unit.

2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

3. Both refrigerant lines shall be insulated from the outdoor unit.

4. Return air shall be through a resin net mold resistant filter.

5. The indoor units shall be equipped with a condensate pan.

6. The indoor units shall be equipped with a return air thermistor.

7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

8. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:

1. The cabinet shall be affixed to a factory supplied wall/ceiling hanging brackets and located in the conditioned space.

2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:

1. The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available.

2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 62W to 130W.

3. The airflow rate shall be available in high and low settings.

4. The fan motor shall be thermally protected.

F. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

3. The coil shall be a 2-row cross fin copper evaporator coil with 15 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1 inch outside diameter PVC.

5. A thermistor will be located on the liquid and gas line.

6. A condensate pan shall be located in the unit.

G. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.

2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:

1. The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.

2. The unit shall be compatible with interfacing with a BMS system via BACnet gateway.

3. The unit shall be compatible with an advanced multi-zone controller.

I. Optional Accessories:


2. A condensate pump.

4.09 WALL MOUNTED UNIT

A. General: Indoor units shall be a wall mounted fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall within a conditioned space. Units shall be connected to outdoor unit heat pump or heat recovery model. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment. The indoor units sound pressure shall range from 31 dB(A) to 41 dB(A) at low speed measured at 3.3 feet below and from the unit.

B. Performance: Each unit’s performance shall be as scheduled on the drawings.
C. Indoor Unit:

1. The indoor units shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The drain pipe can be fitted to from either left or right sides.

2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

3. Both refrigerant lines shall be insulated from the outdoor unit.

4. Return air shall be through a resin net mold resistant filter.

5. The indoor units shall be equipped with a condensate pan.

6. The indoor units shall be equipped with a return air thermistor.

7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

8. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:

1. The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.

2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:

1. The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available.

2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 0.054 to 0.058 HP.

3. The airflow rate shall be available in high and low settings.

4. The fan motor shall be thermally protected.

F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

3. The coil shall be a 2-row cross fin copper evaporator coil with 14 fpi design completely factory tested.

4. The refrigerant connections shall be flare connections and the condensate will be 11/16 inch outside diameter PVC.

5. A thermistor will be located on the liquid and gas line.

6. A condensate pan shall be located in the unit.

G. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.

2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:

1. The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.

2. The unit shall be compatible with interfacing with a BMS system via BACnet gateway.

I. Optional Accessories:


2. A condensate pump

4.10 INDOOR AIR HANDLING UNITS

A. General Description

1. Configuration: Fabricate as detailed on drawings.

2. Shall be same manufacturer as VRV system components.
3. Performance: Conform to AHRI 430. See schedules on prints.

4. Acoustics: Sound power levels (dB) for the unit shall not exceed the specified levels shown on the unit schedule. The manufacturer shall provide the necessary sound treatment to meet these levels if required.

B. Unit Construction

1. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.

2. Panels and access doors shall be constructed as a 2-inch nominal thick; thermal broke double wall assembly, injected with foam insulation with an R-value of not less than R-13.

3. The inner liner shall be constructed of G90 galvanized steel.

4. The outer panel shall be constructed of G90 galvanized steel.

5. The floor plate shall be constructed as specified for the inner liner.

6. Unit will be furnished with solid inner liners.

7. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.

8. The casing leakage rate shall not exceed 0.50 cfm per square foot of casing surface area at design static pressure up to a maximum of +5” w.c. in positive pressure sections and -6” w.c. in negative pressure sections (.0025 m3/s per square meter of cabinet area at 1.24 kPa static pressure)

9. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.

10. Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

11. The unit base shall be provided by others.

12. Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section. Drain connection centerline shall be a minimum of 3” above the base rail to aid in proper
condensate trapping. Drain connections that protrude from the base rail are not acceptable. There must be a full 2” thickness of insulation under drain pan.

C. Fan Assemblies

1. Acceptable fan assembly shall be a double width, double inlet, class I, belt-drive type housed forward curved fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Copper lubrication lines shall be provided and extend from the bearings and attached with grease fittings to the fan base assembly near access door. If not supplied at the factory, contractor shall mount copper lube lines in the field. Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door.

2. Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2” deflection spring vibration type isolators inside cabinetry.

D. Bearings, Shafts, and Drives

1. Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be designed for service with an L-50 life of 200,000 hours and shall be a heavy duty pillow block, self-aligning, grease-lubricated ball or spherical roller bearing type.

2. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

3. V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Fixed sheaves, matched belts, and drive rated based on motor horsepower. Minimum of 2 belts shall be provided on all fans with 10 HP motors and above. Standard drive service factor minimum shall be 1.1 S.F. for 1/4 HP – 7.5 HP, 1.3 S.F. for 10 HP and larger, calculated based on fan brake horsepower.

E. Electrical

1. Fan motors shall be manufacturer provided and installed, Open Drip Proof, premium efficiency (meets or exceeds EPAct requirements), 1750 RPM, single speed. Complete electrical characteristics for each fan motor shall be as shown in schedule.

2. The air handlers shall be UL or ETL listed and labeled. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.
3. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70.

4. Manufacturer shall provide ASHRAE 90.1 Energy Efficiency equation details for individual equipment to assist Building Engineer for calculating system compliance.

5. Installing contractor shall provide GFI receptacle within 25 feet of unit to satisfy National Electrical Code requirements.

6. Air handler manufacturer shall provide, mount and wire variable speed drive with electrical characteristics such as indicated on project schedule and shown on manufacturer's data sheets.

F. Refrigerant Coils

1. Certification: Acceptable refrigerant coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer’s certification and/or the range of AHRI’s standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Forced Circulation Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9002 certified.

2. Direct expansion refrigerant cooling coil shall be provided. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 3” beyond unit casing for ease of installation. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

3. Sweat type copper suction headers shall be provided.

4. Fins shall have a minimum thickness of 0.0075 inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.
5. Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins on 1 1/2-inch centers, brazed at joints.

6. Sweat type copper suction connections located at the bottom of the suction headers for gravity oil drainage. Coils shall be uniformly circuited in a counterflow manner for either single circuit, row, face, interlaced, or interlaced face split capacity reduction as shown on unit schedule. Pressure type liquid distributors used. Coils shall be tested with 315 pounds air pressure under warm water, and suitable for 250 psig working pressure.

7. Coil casing shall be a formed channel frame of galvanized steel.

G. Filters


2. Filter media shall be UL 900 listed, Class I or Class II.

3. Filter Magnehelic gauge(s) shall be furnished and mounted by others.

4.11 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-drive fan.

2. Filters:
   a. Provide 1 complete set of filters to be installed immediately prior to Testing, Adjusting and Balancing work.
   b. Furnish 2 additional complete sets to the owner and obtain receipt.

END OF SECTION
SECTION 26 05 00 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Codes and Standards: Where indicated, the referenced edition shall govern. Where not indicated, the latest edition shall govern.

1.2 SUMMARY

A. This Section includes the following:

1. Supporting devices for electrical components.
2. Electrical identification.
3. Concrete equipment bases.
4. Control wiring.
5. Electrical demolition.
6. Cutting and patching for electrical construction.
7. Touchup painting.

1.3 SUBMITTALS

A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

B. Record Drawings: Where installed circuit designations do not match the Drawings, indicate actual designations.

1.4 DEFINITIONS

A. General Explanation: A substantial amount of the Contract Document Specification language constitutes specific definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated thereon. Certain terms used repetitiously in the Contract Documents are defined generally in this Article.

B. General Requirements: The provisions or requirements of the Division 1 Sections. The General Requirements apply to the entire work of the Contract, and where so indicated, to other elements of work which are included in the project.

C. Indicated: The term "Indicated" is a cross reference to details, notes or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar means of recording
requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping the reader locate the cross reference, and no limitation of location is intended except as specifically noted.

D. Directed, Requested, Etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by the Architect," "requested by the Architect," etc. However, no such implied meaning will be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.

E. Refer: Used to indicate that the subject is defined or specified in further detail at another location in the Contract Documents, or elsewhere as indicated. Except as otherwise noted, "refer" does not imply that the Contractor must purchase or subcontract the subject work in any special manner.

F. Approve: Where used in conjunction with the Architect's response to submittals, requests, applications, inquiries, reports and claims by the Contractor, the meaning of the term "approved" will be held to the limitations of the Architect's responsibilities and duties as specified in the General and Supplementary Conditions. In no case will "approval" by the Architect be interpreted as a release of the Contractor from responsibilities to fulfill the requirements of the Contract Documents.

G. Project Site: The space available to the Contractor for the performance of the work, either exclusively or in conjunction with others performing other work as part of the project. The extent of the project site may or may not be identical with the description of the land upon which the project is to be built.

H. Furnish: Except as otherwise defined in greater detail, the term "furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

I. Install: Except as otherwise defined in greater detail, the term "install" is used to describe operations of the project site including unloading, unpacking, assembly, erection, placing, anchoring, connecting utilities, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

J. Provide: Except as otherwise defined in greater detail, the term "provide" means furnish and install, complete and ready for the intended use, as applicable in each instance.

K. Installer: The entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

1.5 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.
B. Comply with NFPA 70 (2014).

1.6 HAZARDOUS MATERIALS

A. Asbestos: No asbestos-containing materials have been identified on items that are indicated to be disturbed. If asbestos-containing materials are encountered, comply with the following:

1. Upon encountering any previously unidentified materials which he suspects may contain asbestos, the Contractor shall immediately cease all work in the immediate vicinity of the suspected materials and notify the Designer and the Owner. The Owner shall retain consultants to identify the suspected materials. Upon identification, the Owner reserves the right to contract separately for the removal, or require the Contractor to remove said materials in accordance with the following provision. In any case, the work shall be performed by a licensed and certified Abatement Contractor.

2. The Louisiana Department of Environmental Quality (D.E.Q.) has issued the Louisiana Emission Standards for Hazardous Air Pollutants. Where asbestos is encountered in a project, the Contractor shall comply with all laws and ordinances pertaining to asbestos handling and abatement, including the latest revision of LAC 33:111, Chapter 25, Subchapter F, Emission Standards for Hazardous Air Pollutants, LAC 33:111, Chapter 27, Asbestos Containing Materials in Schools and Public Buildings and LAC 33:111, Chapter 51, Subchapter M, Section 5151, Emission Standards for Asbestos.

3. Notification should be addressed to: Asbestos Coordinator; Louisiana Department of Environmental Quality; Air Quality Division; Post Office Box 82135; Baton Rouge, LA 70884-2135

4. If the Owner chooses to remove any previously unidentified materials by utilizing different Contractors, the Contractor shall cooperate fully with the Owner's consultants and asbestos abatement Contractor permitting them full access to the project, and shall not resume work in the vicinity of the suspected materials until advised by the Designer and the Owner that it is safe to do so.

1.7 COORDINATION

A. The electrical Plans and Specifications are a portion of the entire project. Other portions of the project contain information and requirements that will affect the electrical work. It is the responsibility of the Electrical Contractor to review all of the Contract Documents and to include those requirements in the bid.

B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the work. Coordinate installing large equipment requiring positioning before closing in the building.
D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

E. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16 inch (14 mm) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Expansion Anchors: Carbon-steel wedge or sleeve type.

G. Toggle Bolts: All-steel springhead type.


2.2 ELECTRICAL IDENTIFICATION

A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each cable size.

1. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.

C. Colored Adhesive Marking Tape for Wires, and Cables: Self-adhesive vinyl tape, not less than 3/4 inch wide by 3 mils thick (18 mm wide by 0.08 mm thick).

D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:

1. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend that indicates type of underground line.

E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16 inch (1.6 mm) minimum thickness for signs up to 20 sq. inch (129 sq. cm) and 1/8 inch (3.2 mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.

G. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.

H. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396 inch (1 mm), galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4 inch (6 mm) grommets in corners for mounting.

I. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 CONCRETE BASES

A. Concrete: 3000 psi (20.7 MPa), 28-day compressive strength as specified in Division 3 Section 03300, "Cast-in-Place Concrete."

2.4 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom, but no less than that required by NEC.

B. Clearances: Coordinate with other trades and/or existing conditions to maintain code required clearances above, below and around electrical equipment.
C. Materials and Components: Install level, plumb, and square to other building systems and components, unless otherwise indicated.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Selection of Supports: Comply with manufacturer's written instructions.

D. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200 lb (90 kg) design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps. Clamps less than 7 feet above the floor shall be one-piece without protruding edges or bolts.

F. Install 1/4 inch (6 mm) diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2 inch (38 mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports. Support wires shall be dedicated to the support of electrical materials and equipment. Ceiling support equipment and wires are not to be used for the support of electrical equipment. Identify electrical support wires as required by 2011 NFPA 70 300.11(A)(2).

H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers
are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.

I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength. Field galvanize galvanized members that have been field cut.

J. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

K. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
5. Steel: Welded threaded studs or spring-tension clamps on steel. No field welding of supports to structural members will be allowed.
6. Light Steel: Sheet-metal screws. Do not penetrate outer skin of building from within.
7. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 IDENTIFICATION MATERIALS AND DEVICES

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

E. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches (150 to 200 mm) below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm), overall, use a single line marker.
F. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.

G. Color-code 120/240-V three phase system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.

H. Color-code 120/240-V single phase system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black.
2. Phase B: Red.

I. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Brown.
2. Phase B: Orange.
3. Phase C: Yellow.

J. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

K. Install engraved-laminated signs with black letters on white background with minimum 3/8 inch (9 mm) high lettering for equipment designations for switchgear or description of load being fed or controlled in the case of disconnects or contactors.

3.5 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials shall be fire resistant per ASTM E119 fire test conditions and shall be non-combustible when tested per ASTM E136. Melting point shall exceed 2000 degrees F. per ASTM C24. Fireproofing installation for openings in rated floors or partitions shall provide an airtight seal.
3.6 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000 psi (20.7 MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.7 EQUIPMENT AND CONTROL WIRING

A. Wire in and connect every motor and item of equipment furnished as a part of this contract, including those furnished under other Divisions. Provide all required disconnecting means, boxes, conduit, conductors, etc. Motors and equipment furnished under other Divisions will be installed under that Division.

B. Motor starters will be furnished under the division that the motors being controlled are furnished, and will be installed under Division 26 by the Electrical Contractor unless controllers are integral to the equipment. Installation includes mounting, connection to power and grounding.

C. Control Wiring: All control wiring and interlock wiring is included in Division 22.

3.8 DEMOLITION

A. Protect existing electrical equipment and installations not indicated to be removed. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, appearance and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Existing Work to Remain: Maintain feed, or provide new feed to equipment and devices that are not being removed.

E. Remove demolished material from project site.

F. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.9 SEQUENCING AND SCHEDULING

A. Electrical power and system interruptions shall be held to a minimum and will be permitted only at times approved by the Owner. The Owner may require that any interruptions be during
nights, weekends, holidays, etc. Provide any required overtime work at no additional cost to Owner.

B. Do not interrupt feed to any service, feeder or branch circuit feeding facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to make temporary provisions where required according to requirements indicated:

1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.
3. Provide all temporary facilities and services, including fire watch, required to maintain operation, security, and life safety.

3.10 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.11 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Supporting devices for electrical components.
2. Electrical identification.
3. Concrete bases.
4. Electrical demolition.
5. Cutting and patching for electrical construction.
6. Touchup painting.

3.12 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint: Paint materials and application requirements are specified in Division 9 "Painting."

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.13 CLEANING AND PROTECTION

A. Upon completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00
SECTION 26 05 19 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS
A. Field Quality-Control Test Reports: From Contractor.

1.4 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.
B. Comply with NFPA 70 (2014).

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES
A. Manufacturers:
   2. General Cable Corporation.
B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
C. Conductor Material: Copper complying with NEMA WC 5 or 7; stranded or solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
D. Conductor Insulation Types: Type THHN-THWN or XHHW complying with NEMA WC 5 or 7 as applicable.
2.2 CONNECTORS AND SPLICES

A. Manufacturers:
   1. AFC Cable Systems, Inc.
   2. AMP Incorporated/Tyco International.
   3. Hubbell/Anderson.
   4. O-Z/Gedney; EGS Electrical Group LLC.
   5. 3M Company; Electrical Products Division.
   6. Ideal

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated. Push in splice and insulation displacement type connectors shall not be used.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Feeders and Branch Circuits: Type THHN-THWN, XHHW or USE single conductors in raceway. Minimum size #12 AWG or larger where required for voltage drop. Where branch circuits exceed 100 feet in length, use minimum #10 AWG. Wire size in raceways containing multiple neutrals shall be minimum #10 AWG.

B. Fire Alarm Circuits: Type THHN-THWN, in raceway or Power-limited, fire-protective, signaling circuit cable in raceways. Size as recommended by equipment manufacturer or as specified in fire alarm specifications.

C. Class 1 Control Circuits: Type THHN-THWN, in raceway. Minimum size #14 AWG.

D. Class 2 Control Circuits: Type THHN-THWN, in raceway or Power-limited cable in raceways. Size as recommended by equipment manufacturer.

3.2 INSTALLATION

A. Run all conductors and cables in raceways unless specifically indicated otherwise. Where cables are specifically indicated to be run open, use plenum type.

B. Where cables are indicated to be run open, install in a neat and workmanlike manner, as required by NFPA 70, 720-11, 770-24, 800-21, and 820-24. Cables shall be supported by the building structure in such a manner that the cable will not be damaged by the building use. Installation materials and methods shall follow industry standard ANSI/EIA/TIA 568-1991 and 569-1990. Do not lay cables on ceilings. Supporting and structure attachment devices shall be identified for the application. Provide electrical channel to bridge structure where necessary to maintain required supporting intervals. With all cables, but particularly communication cables, do not bend during installation or install such that bend radius is less than industry standards and manufacturer's recommendations.
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. Seal around cables penetrating fire-rated elements according to Division 7.

F. Identify and color-code conductors and cables according to Division 26 Section, "Basic Electrical Materials and Methods."

G. No more than three current carrying phase conductors (excluding switch legs and grounded conductors), and one grounding conductor, may be installed in any raceway.

H. Provide a separate grounded conductor (neutral) for each 120 volt and 277 volt branch circuit; do not use common neutrals.

3.3 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 and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19
SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Data: For the following:

1. Ground rods.

C. Field Test Reports: Submit written test reports to include the following:

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.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 (2014), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grounding Conductors, Cables, Connections, and Rods:

   a. Apache Grounding/Erico Inc.
   b. Chance/Hubbell
   c. Copperweld Corp.
   d. Erico Inc.; Electrical Products Group
   e. Ideal Industries, Inc.
   f. ILSCO
   g. Kearney/Cooper Power Systems
   h. O-Z/Gédény Co.; a business of the EGS Electrical Group
   i. Raco, Inc.; Division of Hubbell
   j. Thomas and Betts, Electrical

2.2 GROUNDING CONDUCTORS

   A. For insulated conductors, comply with Division 26 Section, "Conductors and Cables."
   B. Material: Copper.
   C. Equipment Grounding Conductors: Insulated with green-colored insulation.
   D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
   E. Bare Copper Conductors: Comply with the following:


2.3 CONNECTOR PRODUCTS

   A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
   B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
   C. Twist-on Connectors: Plastic body with coiled copper alloy wire forming threads.
   D. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.
   E. Underground Mechanical Connectors: Bolted-pressure type or compression type, listed for underground application.

2.4 GROUNDING ELECTRODES

   A. Ground Rods: Copper-clad steel, 3/4" dia by 120" long.
PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections except these at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted clamp type or compression connectors for conductors larger than 10 AWG. Use Plastic body twist-on connectors for 10AWG and smaller.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

3.3 INSTALLATION

A. Ground Rods:

1. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding 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.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified and at service disconnect enclosure grounding terminal. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
   a. Equipment Rated 500 kVA and Less: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
SECTION 26 05 33 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
   B. Related Sections include the following:
      1. Division 26 Section, "Basic Electrical Materials and Methods," for supports, anchors, and
         identification products.
      2. Division 26 Section, "Wiring Devices," for devices installed in boxes, and for floor-boxes.

1.3 DEFINITIONS
   A. EMT: Electrical metallic tubing.
   B. FMC: Flexible metal conduit.
   C. IMC: Intermediate metal conduit.
   D. LFMC: Liquidtight flexible metal conduit.
   E. RNC: Rigid nonmetallic conduit.
   F. Fixture Whip: Flexible wiring as specified from box to individual lighting fixture.

1.4 SUBMITTALS
   A. Product Data: For raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and
      cabinets.
   B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings,
      boxes, enclosures, and cabinets.
1.5 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.

B. Comply with NFPA 70 (2014).

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING AND RACEWAY SYSTEMS

A. Manufacturers:

1. Anamet Electrical, Inc.; Anaconda Metal Hose.
2. Electri-Flex Co.
3. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
4. LTV Steel Tubular Products Company.
5. Manhattan/CDT/Cole-Flex.
6. O-Z Gedney; Unit of General Signal.
7. Wheatland Tube Co.


E. Plastic-Coated IMC and Fittings: NEMA RN 1.


1. Fittings, 2 Inch Diameter and Larger: Steel (not die cast) set-screw or compression type.
2. Fittings, Smaller than 2 Inches Diameter: Compression type.

G. FMC: Zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings: NEMA FB 1; compatible with conduit and tubing materials.
2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:
   2. Anamet Electrical, Inc.; Anaconda Metal Hose.
   3. Arnco Corp.
   4. Cantex Inc.
   7. ElecSYS, Inc.
   8. Lamson & Sessions; Carlon Electrical Products.
   10. RACO; Division of Hubbell, Inc.

B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS

A. Manufacturers:
   1. Hoffman.
   2. Square D.
   3. Times Square.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include 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. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Screw-cover type.

F. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

   1. Manufacturers:
      a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
      b. Thomas & Betts Corporation.
2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. Emerson/General Signal; Appleton Electric Company.
   3. Erickson Electrical Equipment Co.
   6. O-Z/Gedney; Unit of General Signal.
   7. RACO; Division of Hubbell, Inc.
   10. Spring City Electrical Manufacturing Co.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Floor Boxes: Fully adjustable, or Cast metal, with brass flip-lid covers matching indicated devices, and carpet flange as required. All boxes in slab-on-grade applications shall be cast metal type.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.6 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.
PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Use the following raceways for outdoor installations:

1. Exposed: IMC.
2. Concealed: IMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment: LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.

B. Use the following raceways for indoor installations:

1. Exposed in Unfinished Areas: EMT. Use IMC or Rigid Steel Conduit for locations subject to mechanical damage.
2. Exposed in finished areas: Surface metal raceway where concealment is impossible. Limit use to the least possible. The impossibility of concealment is in the opinion of the Architect.
3. Concealed: EMT.
4. Connection to Vibrating Equipment: FMC; except in wet or damp locations, use LFMC.
5. Damp or Wet Locations: IMC.
6. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise indicated.

C. Minimum Raceway Size: 1/2-inch trade size (DN 14) unless noted. 3/8-inch factory assembled, flexible steel "fixture whips," a maximum of 60 inches long, may be used to feed individual lay-in fluorescent lighting fixtures.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.2 INSTALLATION

A. 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 piping.

B. Do not support electrical equipment or raceways from ceiling grid or ceiling grid supports. Independently support all equipment and raceways directly from structural elements.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section, "Basic Electrical Materials and Methods."
E. Install temporary closures to prevent foreign matter from entering raceways.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Conceal raceways within finished walls, ceilings, and floors unless concealment is impossible or where otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

I. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1 inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to rigid steel conduit or IMC before rising above the floor.

J. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

K. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

L. Tighten set screws of threadless fittings with suitable tools.

M. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
N. 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.

O. Telephone and Signal System Raceways, 2 Inch Trade Size (DN 53) and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet (45 meters) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor.

Q. Flexible Connections: Use maximum of 60 inches (1725 mm) of flexible conduit for recessed and semirecessed lighting fixtures. Use maximum of 12 inches (35 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

R. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

S. Set floor boxes level and flush with finished floor surface.

T. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 05 33
SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes the following lighting control devices:
      1. Outdoor photoelectric switches.
      2. Indoor occupancy sensors.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Field quality-control test reports.
   C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.4 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.
   B. Comply with NFPA 70 (2014).

PART 2 - PRODUCTS

2.1 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS
   A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.
2.2 SWITCH-BOX OCCUPANCY SENSORS

A. Manufacturers:

2. Lightolier Controls; a Genlyte Company.
3. Lithonia Lighting.
4. Novitas, Inc.
5. Sensor Switch, Inc.
6. Watt Stopper (The).

B. Description: Dual-Technology type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; and rated for 1000 W at 277-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/3-hp motors, minimum.

1. Include ground wire.
2. 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.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
4. 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.
5. 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.

6. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
7. Bypass Switch: Override the on function in case of sensor failure.

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 and 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 at least 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving at least 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. feet (93 sq. meters) when mounted on a 96-inch- (2440-mm-) high ceiling.
2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Division 26 Section, "Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section, "Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

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.

F. 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 and UL 486B.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section B, "Basic Electrical Materials and Methods."

3.4 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 actuation of each sensor and adjust time delays.
B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 26 09 23
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes the following:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.
   3. Transient voltage suppression panelboards.

1.3 DEFINITIONS
A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS
A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression 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. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of panelboards and overcurrent protective devices.
      d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Wiring Diagrams: Power, signal, and control wiring.
C. Qualification Data: For testing agency.
D. Field quality-control test reports including the following:
   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.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, 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.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Material and Equipment."

C. 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.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70 (2014).

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not exceeding 104 degrees F (40 degrees C).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.

C. 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 seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 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, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 MANUFACTURED UNITS

A. Enclosures: Flush- and surface-mounted cabinets as indicated. NEMA PB 1, Type 1.

1. Rated for environmental conditions at installed location.

   a. Outdoor Locations: NEMA 250, Type 3R.
   c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.


B. Phase and Ground Buses:


2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground 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.
C. Conductor Connectors: Suitable for use with conductor material.
   1. Main and Neutral Lugs: Mechanical type.
   2. Ground Lugs and Bus Configured Terminators: Mechanical type.
   3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

D. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

A. Manufacturers: Products: Subject to compliance with requirements, provide one of the products specified.
   2. General Electric: Spectra Series
   3. Siemens: Sentron S4 or S5
   4. Square-D: I-Line

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

C. Main Overcurrent Protective Devices: Circuit breaker (where scheduled).

D. Branch Overcurrent Protective Devices:
   1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
   2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Products: Subject to compliance with requirements, provide one of the products specified.
   1. Cutler-Hammer: PRL1a (120/208V); PRL2a (277/480V).
   2. General Electric: AQ Series (120/208V); AE Series (277/480V).
   3. Siemens: Sentron S1 (120/208V); Sentron S2 (277/480V).
   4. Square-D: NQOD (120/208V); NF(277/480V).

B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
C. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 TRANSIENT VOLTAGE SUPPRESSION PANELBOARDS

A. Manufacturers: Products: Subject to compliance with requirements, provide one of the products specified.
   1. Cutler-Hammer: As specified above with integral "Clipper" TVSS
   2. General Electric: As specified above with integral "ME" TVSS.
   3. Siemens: As specified above with integral "TPS" TVSS.
   4. Square-D: As specified above with integral "Surge Logic" TVSS.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

C. Main Overcurrent Devices: Thermal-magnetic circuit breaker.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

E. Bus: Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.

   1. Minimum Single-Impulse Current Ratings:
      a. Line to Neutral: 100,000.
      b. Line to Ground: 100,000.
      c. Neutral to Ground: 50,000.
   2. Protection modes shall be as follows:
      a. Line to neutral.
      b. Line to ground.
      c. Neutral to ground.
   3. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
   4. Maximum UL 1449 Clamping Levels: 400 V, line to neutral and line to ground on 120/208 V & 800 V, line to neutral and line to ground on 277/480 V systems.
   5. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.
   6. Accessories:
      a. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
      b. Audible alarm activated on failure of any surge diversion module.
      c. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.
2.7 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Full module, inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Tandem or "piggyback" breakers are not acceptable.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Install overcurrent protective devices and controllers.
   1. Set field-adjustable circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Create a directory to indicate installed circuit loads. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section, "Grounding and Bonding."

B. Connect wiring according to Division 26 Section, "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

3.5 CLEANING

A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 24 16
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes the following:
      1. Duplex receptacles.
      2. Single receptacles.
      4. Integral surge suppression units, and isolated-ground receptacles.
      6. Three-way switches.
      7. Double-pole switches.
      8. Dimmer switches.
     10. Multioutlet surface metal raceway assemblies.

1.3 DEFINITIONS
   A. GFCI: Ground-fault circuit interrupter.
   B. TVSS: Transient voltage surge suppressor.
   C. EMI: Electromagnetic interference.
   D. UTP: Unshielded twisted pair.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE
   A. Source Limitations: Obtain each type of wiring device 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 NFPA 70 (2014).

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type of wiring device):

1. Single Pole Toggle Switch, 120-277V, 20A:
   a. Hubbell #HBL1221.
   b. Leviton #1221-2.
   c. P & S #20-AC-1.

2. Two Pole Toggle Switch, 120-277V, 20A:
   a. Hubbell #HBL1222.
   b. Leviton #1222-2.

3. Three-Way Toggle Switch, 120-277V, 20A:
   a. Hubbell #HBL1223.
   b. Leviton #1223-2.
   c. P & S #20-AC-3.

4. Single Pole Toggle Switch with Pilot Light, 120V, 20A:
   a. Hubbell #HBL1221PL.
   b. Leviton #1221-PL.
   c. P & S #20-AC1-CPL.

5. Single Pole Toggle Switch with Pilot Light, 277V, 20A:
   a. Hubbell #HBL1221PL.
   b. Leviton #1221-7P.
   c. P & S #20-AC1-RPL7.

6. Three Way Toggle Switch with Pilot Light, 120V, 20A:
   a. Hubbell #HBL1223PL.
   b. Leviton #1223-PL.
   c. P & S #20-AC3-CPL.
7. Duplex Receptacle, 125V-1φ-20A:
   a. Hubbell #HBL5362.
   b. Leviton #5362.
   c. P & S #5362A.

8. GFCI Receptacles, 125V-1φ-20A:
   a. Hubbell #HBL-GF-5362.
   b. Leviton #8899.
   c. P & S #2091-S.

9. Duplex Receptacle, Isolated Ground, 125V-1φ-15A:
   a. Hubbell #IG8210.
   b. Leviton #8200IG.
   c. P & S #1G5261.

10. Tamper Resistant (Safety) Receptacles, 125V-1φ-20A:
    a. Leviton #8300-SGX.
    b. P & S #TR63-HX.

11. Dryer Receptacles, 250V-1φ-30A, NEMA 10-30R:
    a. Hubbell #HBL 9350.
    b. Leviton #5207.
    c. P & S #3860.

12. Solid State Wall Box Dimmers:
    a. Leviton "Monet" Series, incandescent or fluorescent type to match load.
    b. Lutron "Nova T-Star" Series, incandescent or fluorescent type to match load.

13. Single Gang Flush Floor Outlets:
    a. Hubbell #B2436/S3825/SB3083 (if floor is carpeted).
    b. Walker-Wiremold #880CS1/828R/817B (if floor is carpeted).

14. Motor Rated Switches and Manual Motor Starters:
    b. Square-D FG or KG Series.
    c. P & S 78XX Series.

2.2 DEVICE PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035 inch (1 mm) thick, satin-finished stainless steel. Material for Unfinished Spaces: Galvanized steel.

3. Material for Wet Locations: Thermoplastic, with spring-loaded lift cover, and listed and labeled for use in "wet locations." For receptacles, listing shall apply with plug cap inserted.

2.3 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions. Where switches are mounted adjacent to dimmers, switch shall be that dimmer manufacturer's companion device, matching dimmer style.

C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

D. 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. Provide dimmer manufacturer's custom companion plates where dimmers and switches are mounted together.

E. Remove wall plates and protect devices and assemblies during painting.

3.2 MOUNTING HEIGHTS

A. Mount toggle switches at 48 inches above finished floor to center of toggle handle.

B. Mount receptacles, telephone outlets and data outlets 18 inches above finished floor to center of receptacle unless specifically noted otherwise.

C. Mount devices above counters at 2 inches from bottom of device to top of counter, or counter backsplash.

3.3 IDENTIFICATION

A. Comply with Division 26 Section, "Basic Electrical Materials and Methods".
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.

### 3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section, "Grounding and Bonding."

B. Connect wiring according to Division 26 Section, "Conductors and Cables."

C. 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 and UL 486B.

D. Do not connect stranded wire to devices using back wired push-in feature.

E. When terminating stranded conductors on devices, ends of strands shall be contained by insulation so that all strands must be held by screw.

### 3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

**END OF SECTION 26 27 26**
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches.

1.3 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables, and related data.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 1, include the following:

   a. Let-through current curves for fuses with current-limiting characteristics.
   b. Time-current curves, coordination charts and tables, and related data.
   c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses 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 NEMA FU 1.

D. Comply with NFPA 70 (2014).

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 degrees F (5 degrees C) or more than 100 degrees F (38 degrees C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to one complete set of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussman, Inc.
2. Ferraz Shawmut, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Motor Branch Circuits: Dual element, time delay, current limiting, Class RK5.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 26 28 13
SECTION 26 28 16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes individually mounted enclosed switches used motor and equipment disconnecting means.

B. Related Sections include the following:

1. Division 26 Section, "Fuses," for overcurrent protective devices installed in switches.

1.3 DEFINITIONS

A. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of switch, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Field Test Reports: Submit written test reports and include the following:

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.

C. Maintenance Data: For enclosed switches and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:

1. Routine maintenance requirements for components.
2. Manufacturer's written instructions for testing and adjusting switches.
1.5 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.

B. Comply with NEMA AB 1 and NEMA KS 1.

C. Comply with NFPA 70 (2014).

1.6 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 degrees F (minus 30 degrees C) and not exceeding 104 degrees F (40 degrees C).

1.7 COORDINATION

A. Coordinate layout and installation of switches and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Fusible Switches:

      a. Eaton Corp.; Cutler-Hammer Products. DH Series
      b. General Electric Co.; Electrical Distribution & Control Division. Type "TH"
      d. Square D Co. "H" Series

2.2 ENCLOSED SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.
2.3 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
   1. Outdoor Locations: NEMA 250, Type 3R.
   3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

B. Switches shall be mounted so that operating handle is up when switch is on and down when it is off.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section, "Basic Electrical Materials and Methods."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws. Indicate load designation.

3.4 CONNECTIONS

A. Install equipment grounding connections for switches with ground continuity to main electrical ground bus.

B. Connect lightning arresters.

C. Install power wiring. Install wiring between switches and equipment.
D. 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 and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each enclosed switch and component.
   2. Test continuity of each line- and load-side circuit.

B. Testing: After installing enclosed switches and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
   1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5. 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.

3.6 CLEANING

A. Upon completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 28 16
SECTION 26 43 13 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes surge protective device at exterior HVAC equipment containing hermetic compressors.
   B. Related Sections include Division 26 Section, "Panelboards," for factory-installed SPDs.

1.3 DEFINITIONS
   B. SVR: Suppressed voltage rating.
   C. TVSS: Transient voltage surge suppressor.
   D. SPD: Surge Protective Devices (SPD's).

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.
   B. Product Certificates: For SPD's, signed by product manufacturer certifying compliance with the following standards:
      1. UL 1283.
   C. Operation and Maintenance Data: For SPD's to include in emergency, operation, and maintenance manuals.
   D. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE
   A. Source Limitations: Obtain SPD's and accessories through one source from a single manufacturer.
   B. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of SPD's and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
C. 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.

D. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."

E. Comply with NFPA 70 (2014).

1.6 PROJECT CONDITIONS

A. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 degrees F (0 to 50 degrees C).
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet (6090 meters) above sea level.

1.7 COORDINATION

A. Coordinate location of SPD's to allow adequate clearances for maintenance.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within one year from date of Final Inspection.

PART 2 - PRODUCTS

2.1 SECONDARY SURGE ARRESTORS

A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:

1. LED indicator lights for power and protection status.
2. Knockout mounted.


C. Connection Means: Permanently wired.

D. Manufacturers:

1. 120/208V, three phase

   a. Cutler Hammer 2-CHSA01
   b. General Electric 2-9L15FCB001
   c. Joslyn 1455-21
   d. Square-D 2-SDSA1175
PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

A. Install devices at each exterior item of mechanical equipment having a hermetic compressor. Connect on line side of local disconnect, with ground lead bonded to branch circuit ground.

B. Make arrester leads as short as possible and keep radius of bends in wire as large as is practical.

3.2 PLACING SYSTEM INTO SERVICE

A. Do not energize or connect HVAC equipment to their sources until SPD's are installed and connected.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform the following field tests and inspections and prepare test reports:

1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 43 13
SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures with LED arrays and electronic drivers.
2. Lighting fixtures mounted on exterior building surfaces.
3. Emergency lighting units.
4. Exit signs.
5. Accessories.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices," for manual wall-box dimmers for incandescent lamps.
2. Division 26 Section "Lighting Control Devices," for automatic control of lighting, including, photoelectric relays and occupancy sensors.

1.3 DEFINITIONS

A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.

B. Correlated Color Temperature (CCT) – a visible light characteristic of comparing a light source to a theoretical, heating black body radiator (measured in degrees kelvin).

C. CRI: Color rendering index.

D. CU: Coefficient of utilization.

E. Effective Projected Area (EPA) – the wind loading of the fixture.

F. International Protection (IP) Rating – delineates the level at which foreign objects and water can intrude inside a device.

G. Restriction of Hazardous Substances (RoHS) – products that are RoHS-compliant do not contain any of the following materials: lead (Pb), mercury (Hg), cadmium (Cd), hexavalent

H. Useful Life – the operating hours before reaching 70% of the initial rated lumen output point with no catastrophic failures under normal conditions.
I. **LER**: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:

1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.

J. **RCR**: Room cavity ratio.

K. **Fixture Whip**: Flexible wiring as specified from box to individual lighting fixture.

1.4 **SUBMITTALS**

A. **Product Data**: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.
2. Emergency lighting unit battery and charger.
3. Fluorescent and high-intensity-discharge ballasts.
4. Lamps.

B. **Wiring Diagrams**: Power, signal, and control wiring.

C. **IESNA LM-79 report** on manufacturer’s standard production model luminaire to include:

1. Testing agency, report number, date, manufacturer’s name, catalog number, LED driver, drive current, ambient temperature.
2. Luminaire efficacy (lumens/watt), minimum light output, zonal lumen density.
3. Color qualities (CCT, CRI, chromaticity).
4. ANSI C78.377 Duv.
5. Electrical measurements (input voltage, input current, input power).
6. Spectral distribution over visible wavelengths (mW/nm).
7. Absolute intensity candlepower (cd) summary table.
8. Isocandela plot
9. Photometric file, including BUG rating.

D. **IESNA LM-80 report** on LED package, array, or module, to include:

1. Testing agency, report number, date, type of equipment, and LED light source being tested.
2. All data required by IESNA LM-80.

E. **Field quality-control test reports**.

F. **Operation and Maintenance Data**: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:

1. Catalog data for each fixture. Include the diffuser, driver, and LED's installed in that fixture.
G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

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 NFPA 70 (2014).

D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Unit Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period: five years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining four years.

B. SPECIAL WARRANTY FOR LED LUMINAIRES

1. The LED manufacturer shall provide a written five-year on-site replacement “finish” warranty for luminaires. Finish warranty shall include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

2. The LED manufacturer shall provide a written five-year on-site replacement warranty for defective or non-starting power supply units and LED source assemblies, which include, but are not limited to, LED packages, LED arrays, LED modules, LED dies, encapsulates, and phosphors.

3. The LED manufacturer shall provide a written five-year on-site replacement warranty for any LED source assembly, package, array, or module, which does not include the power supply, against 10% or more of the individual LEDs in that assembly, package, array, or module failing to illuminate.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. As specified on the drawings or with approval prior to the bid. Approval granted prior to bid is subject, after the bid, to comparison with the specified equipment and to compliance with the plans, specifications and space limitation requirements.

2.2 FIXTURES AND COMPONENTS, GENERAL

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. LED Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A. Provide luminaires complete with LED light source and power supply unit. Details, shapes, and dimensions are indicative of the general type desired but are not intended to restrict selection to luminaires of a particular manufacturer. Luminaires of similar design, light distribution and brightness characteristics, and of equal finish and quality will be acceptable.

1. Luminaires shall produce a minimum efficacy of 100 lumens per watt.
2. Luminaires shall incorporate modular electrical connections and be constructed to allow replacement of all or part of the optics, heat sinks, power supply units, and electrical components using only a simple tool, such as a screw driver.
3. Luminaires shall bear a nameplate inscribed with the manufacturer’s name, address, model number, date of manufacture, and serial number, securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.
4. Luminaires surge protection to meet “C low” waveforms as defined in ANSI/IEEE C62.41.2, scenario 1 Location C.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit entry without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during inspection and when secured in operating position.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is scheduled.
b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 LIGHTING FIXTURES

A. Fixtures: As scheduled on the Contract Drawings.
   1. Suspended fixtures shall be balanced to hang straight and level.
   2. Continuous rows of fixtures shall be run straight and level; fixture design shall not be susceptible to misalignment after incidental contact.

2.4 LED POWER SUPPLY UNITS

A. Efficiency: 85%.
B. Maximum drive current: 525 mA.
C. Operating temperature: -30°C to +40°C.
D. Operating voltage: 120V to 277V nominal. Fluctuations in line voltage up to 15% shall have no visible effect on the luminous output.
E. Operating frequency: 50/60 Hz.
F. Power factor (PF) > 0.90.
G. Total current harmonic distortion (THD) for current: < 20%.
H. Comply with FCC 47 CFR Section 15, Class B, non-consumer RFI/EMI standards.
I. Reduction of hazardous substances- (RoHS-) compliant.
J. Luminaires under a covered structure shall be UL-listed Class P with a sound rating of “A.”
K. Driver shall be dimmable and compatible with a standard dimming control circuits.
L. Driver shall be protected against damage due to either an open-circuit or short-circuit fault condition on the driver output. The driver shall resume normal operation when the fault is removed.
M. Over-temperature protection shall be provided to cut off output power if temperature limit is exceeded. The driver shall resume normal operation when within normal operating temperature.

2.5 LED LIGHT SOURCE

A. Correlated color temperature (CCT) shall be in accordance with ANSI C78.377.
1. Nominal CCT: 3000 K: 3045 + 175 K.
2. Nominal CCT: 4000 K: 3985 + 275 K
3. Nominal CCT: 5000 K: 5028 + 283 K.
4. Nominal CCT: 6500 K: 6530 + 510 K.

B. Color Rendering Index (CRI) shall be:
1. > 80 for 3000 K – 3500 K
2. > 70 for 4000 K – 6500 K

C. Thermal management shall be passive by design and shall consist of heat sinks with no fans, pumps, or liquids.

2.6 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

2.7 EMERGENCY LIGHTING UNITS

A. General: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Wire Guard: Where indicated, heavy-chrome-plated wire guard protects lamp heads or fixtures.
5. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored after an outage; time delay permits high-intensity-discharge lamps to restrike and develop adequate output.

2.8 LED EMERGENCY LIGHTING FIXTURES

A. **Internal Type:** Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.
   1. Emergency Connection: Operate to provide 1100 lumen output continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture driver.
   2. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
   3. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.

2.9 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Basic Electrical Materials and Methods," 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 fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage (2.68 mm).

E. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

F. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.10 FINISHES

A. Fixtures: Manufacturers' standard, unless otherwise indicated.
   1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2.11 SOURCE QUALITY CONTROL

A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with drivers and LED arrays; certify results for electrical ratings and photometric data.

B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceilings and walls.

B. Limit length of fixture whips to 60 inches from box to fixture. Do not run from fixture to fixture with flexible wiring.

C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Do not use ceiling grid or grid support wires for support. Support fixtures independently from structure.
   1. Install a minimum of four ceiling support system rods or wires for each tubular fluorescent recessed or surface mounted fixture. Locate not more than 6 inches (150 mm) from fixture corners.
   2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Install at least two independent support rods or wires from structure to tabs on diagonal opposite ends of lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3. Do not use same wires or anchors used to support ceiling.
   4. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees and two independent support rods or wires from structure to lighting fixture.

D. Suspended Fixture Support: As follows:
   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

E. Adjust aimable fixtures to provide required light intensities.

3.2 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 and UL 486B.
3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Verify normal operation of each fixture after installation.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

E. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 26 51 00
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Telecommunications mounting elements.
   2. Backboards.
   3. Telecommunications equipment racks and cabinets.

B. Related Requirements:
   1. Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
   2. Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For communications equipment room fittings. 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. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
   3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division Section "Rough Carpentry."

2.2 EQUIPMENT FRAMES

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. ADC.
2. Belden Inc.
3. Cooper B-Line.
5. Hubbell Premise Wiring.
6. Leviton Commercial Networks Division.
7. Middle Atlantic Products, Inc.
8. Ortronics, Inc.
9. Panduit Corp.
10. Siemon Co. (The).
11. Tyco Electronics Corporation; AMP Products.

B. General Frame Requirements:

1. Distribution Frames: wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Modular Wall Cabinets:

1. Wall mounting.
2. Steel or aluminum construction.
3. Treated to resist corrosion.
4. Lockable front and rear doors.
5. Louvered side panels.
6. Cable access provisions top and bottom.
7. Grounding lug.
10. All cabinets keyed alike.

D. Cable Management for Equipment Frames:
1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.3 POWER STRIPS

A. Power Strips: Comply with UL 1363.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
7. Close-coupled, direct plug-in line cord.
8. Rocker-type on-off switch, illuminated when in on position.
10. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.4 GROUNDING

A. Comply with requirements in Section "Grounding and Bonding" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:
1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with J-STD-607-A.
2.5 LABELING
   A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES
   A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.2 INSTALLATION
   A. Comply with NECA 1.
   B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
   C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
   D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
      1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
      2. Record agreements reached in meetings and distribute them to other participants.
      3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
   E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 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 Division 26 Section "Basic Electrical Materials and Methods."

3.4 FIRESTOPPING
   A. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."
   B. Comply with TIA-569-B, Annex A, "Firestopping."
C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
   1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Electrical Identification."

B. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.

D. Labels shall be preprinted or computer-printed type.

END OF SECTION 27 11 00
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Section, apply to the Section.

1.2 SUMMARY
   A. Section Includes:
      1. UTP cabling.
      2. Cable connecting hardware, patch panels, and cross-connects.
      3. Telecommunications outlet/connectors.
      4. Cabling system identification products.
   B. Related Requirements:
      1. Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.3 ADMINISTRATIVE REQUIREMENTS
   A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
   B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.4 SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings:
      1. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
      2. Wiring diagrams to show typical wiring schematics, including the following:
         b. Patch panels.
         c. Patch cords.
      3. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

D. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

B. Comply with NFPA 70 (2014).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLE DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
   1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
   2. Bridged taps and splices shall not be installed in the horizontal cabling.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

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: 25 or less.
   2. Smoke-Developed Index: 50 or less.

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.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
2. Belden Inc.
3. Berk-Tek; a Nexans company.
4. CommScope, Inc.
5. Draka Cableteq USA.
7. Mohawk; a division of Belden Networking, Inc.
8. Superior Essex Inc.
9. SYSTIMAX Solutions; a CommScope, Inc. brand.
10. 3M Communication Markets Division.
11. Tyco Electronics Corporation; AMP Products.

B. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

   a. Communications, General Purpose: Type CM or CMG.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
3. Belden Inc.
4. Dynacom Inc.
5. Hubbell Premise Wiring.
6. Leviton Commercial Networks Division.
7. Molex Premise Networks; a division of Molex, Inc.
8. Panduit Corp.
10. Tyco Electronics Corporation; AMP Products.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
   1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
   1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm) lengths; terminated with eight-position modular plug at each end.
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS


B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.
   1. Metal Faceplate: Stainless steel, complying with requirements in Section “Wiring Devices.”
   2. For use with snap-in jacks accommodating any combination of UTP work area cords.
      a. Flush mounting jacks, positioning the cord at a 45-degree angle.
   3. Legend: Factory labeled by silk-screening or engraving for stainless steel faceplates.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Basic Electrical Materials and Methods."

2.7 SOURCE QUALITY CONTROL

A. Factory test UTP cables on reels according to TIA/EIA-568-B.1.
B. Cable will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
3. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
4. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."
B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Basic Electrical Materials and Methods."

1. Administration Class: 2.
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.

C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
   a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
   b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.
### 3.6 FIELD QUALITY CONTROL

**A. Perform the following tests and inspections:**

2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. UTP Performance Tests:
   a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss.
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).
      8) Return loss.
      9) Propagation delay.
      10) Delay skew.
6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
   a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
   b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 27 15 00
DIVISION V

DRAWINGS
NSU Student Union
Student Activities Area

Bid Documents

Northwestern State University of Louisiana
Natchitoches, LA 71497
Friedman Student Union Building

Date:
June 5, 2019

SBB Project Number:
1911.00
Demolition Plan Notes:

- All notes are general notes. All notes designated by [x] are for specific locations. See Elevation for general notes.

  1. Remove existing carpet and prep for new flooring.
  2. Remove existing VCT and prep for new flooring.
  3. Existing ceramic floor tile to remain.
  4. Existing concrete floor to remain.
  5. Existing ceramic tile to remain.
  6. Remove existing steel wall system from existing wall or column.
  7. Remove existing 2x4 wood stud wall with one layer of plywood sheathing.
  8. Existing door and frame to remain.
  9. Remove existing window system.
  10. Remove existing storefront door and frame.
  11. Remove portions of existing brick wall for new windows. See Elevation for extent of removal before proceeding.
  12. Remove existing gypsum board and metal stud wall.
  13. Remove existing door and frame.
  14. Remove existing 2x4 or 2x4 lay-in acoustic ceiling grid and tile. Re: Mechanical and Electrical for ceiling grilles and lighting demolition.
  15. Existing toilet accessories to remain in this room.
  16. Existing plumbing fixtures to remain in this room.
  17. Remove existing fire extinguisher cabinet and salvage existing fire extinguisher for reuse.
  18. Existing double wite masonry wall to be removed.
  19. Remove existing concrete curb.
  20. Protect existing construction, equipment, finishes, finishes, etc. from damage during demolition.

Demolition Plan Legend:

- Existing to remain
- Existing to be demolished
Renovation Plan Notes:

All notes designated by * are for specific locations. All other notes are general notes.

- Existing door, transom, and frame to remain, remove rust, prep, and repaint.
- New storefront window, Re: Details on Sheets A3.01 and A3.02.
- New aluminum storefront door to be installed with new continuous hinge in aluminum frame. Prep existing frame to receive new door hardware and paint frame where existing hardware was removed. Contractor to verify size of opening.
- New 2x2 lay-in acoustical ceiling grid and tile, Re: Mechanical and Electrical.
- Ceiling in this room is open to structure; paint matte black all existing structure and new and existing mechanical and electrical above finish floor. Contractor to verify existing bar joist layout and other existing equipment to be painted prior to bidding.
- Where existing brick walls were removed, pour new leveling compound to fill in said height +/- 1/2".
- Existing brick wall, previously painted, repaint. Fill screw holes in mortar and wash down before painting with new paint.
- Existing brick wall, unpainted, to remain, paint wall.
- 12" high platform, steel stud framed with fire retardant treated 3/4" plywood wall joists, Re: Details on Sheet A2.02.
- 2-4" wide ramp, frame same as platform, Re: Details on Sheet A2.02.
- Strip, Re: Detail 4/A2.02.
- Bathrm wall mounted counter, Re: Detail 4/A2.03.
- Built-in free standing counter, Re: Details on Sheet A2.02.
- New concrete sills, Re: Details on Sheet A2.02. Butt tight and seal to steps and edges.
- Existing housing and overhead coiling grille door to remain, repaint housing.
- Install new fire extinguisher cabinet.
- Existing gypsum board, to remain, repaint.
- Location for new ceiling mounted projection screen.
- New aluminum storefront door to be installed in existing aluminum storefront frame. Prep existing frame to receive new door hardware and paint frame where existing hardware was removed. Contractor to verify size of opening.
- Existing HVAC grille to remain, clean and repaint frame.
- New concrete curb, Re: Details on Sheet A2.02. Butt tight and seal to steps and edges.
- Patch concrete where curb has been removed.
- Coordinate with Owner location of retractable projector at ceiling.

Legend:

- New Wall
- Existing Wall

Sheet Title: A1.01

Date: June 5, 2019

Sheet No.
Reflected Ceiling Plan Notes:

All notes designated by are for specific locations. All other notes are general notes.

1. Refer to Electrical and Mechanical drawings for light fixture types and HVAC equipment.
2. New 2’x2’ suspension grid and ceiling tiles in this room.
3. Ceiling in this room is open to structure, paint black all existing structure and new and existing mechanical and electrical above 10’-0” above finish floor.
4. Existing ceiling to remain.
5. Ceiling mounted projector, coordinate with Owner.
6. Retractable projection screen, coordinate with Owner.

All notes designated by are for specific locations. All other notes are general notes.

1. New concrete curb.
2. New reinforcing bars, dowel, and epoxy set into existing paving, Re: Reinforcing Bar Detail.
3. Reinforcing Bar Detail.

2x2 Acoustic Tile / Grid
2x4 LED Light Fixture
Supply diffuser, Re: Mechanical for size
Exhaust Air Grille, Re: Mechanical for size

Sheet No.
Seal

Reflected Ceiling Plan

June 5, 2019
New gypsum board wall, painted

Existing gypsum board wall, repainted

New rubber base

New HVAC grille on brick wall beyond

Existing unpainted brick wall to be painted

New rubber base

Existing brick wall, repainted

New rubber base

Existing wood door and transom to be painted, frame to be repainted

New fire extinguisher cabinet, surface mounted

Existing aluminum storefront to remain

1 Student Multipurpose - North

2 Student Multipurpose - East

3 Student Multipurpose - South

4 Student Multipurpose - West
Door and Frame Types

**Solid Core Wood Door**
- Stain Grade

**Hollow Metal Frame**
- See schedule

**Aluminum Door**
- Narrow Stile
- See schedule

**Existing Wall**
- Wall Thickness - Verify

### Door and Frame Types

1. **Door and Frame Types**
   - See schedule
   - See schedule
   - See schedule
   - See schedule

2. **Door Head - Drywall**
   - Wall Thickness - Verify
   - 5/8" Type X gypsum board
   - 5" header
   - Continuous track
   - Hollow metal frame

3. **Door Jamb - Drywall**
   - 5/8" Type X gypsum board
   - Double structural (gage exists at jamb typically)
   - Hollow metal frame

4. **Door Head - Existing**
   - Existing wall
   - Hollow metal frame

5. **Door Jamb - Existing**
   - Existing wall
   - Hollow metal frame

6. **SF-1**
   - Existing pressed lathed hollow to remain
   - 1" insulated glazing

7. **SF-2**
   - New storefront door with continuous hinge
   - 1" insulated glazing with opaque window film

8. **SF-3**
   - Existing break metal to match storefront framing

9. **SF-4**

10. **SF-5**

11. **Interior Storefront - Head/Jamb**

12. **Interior Storefront - Sill**

13. **Interior Storefront - Door Sill**

**Door Schedule**

<table>
<thead>
<tr>
<th>Door Number</th>
<th>Room Name</th>
<th>Width</th>
<th>Height</th>
<th>Thickness</th>
<th>Material</th>
<th>Door Type</th>
<th>Material Type</th>
<th>Head</th>
<th>Jamb</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>116</td>
<td>Work Area</td>
<td>3' - 0&quot;</td>
<td>7' - 0&quot;</td>
<td>0' - 1 3/4&quot;</td>
<td>Wood</td>
<td>D-B</td>
<td>Hollow Metal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>Corridor</td>
<td>6' - 0&quot;</td>
<td>7' - 0&quot;</td>
<td>0' - 1 3/4&quot;</td>
<td>Wood</td>
<td>D-A</td>
<td>Hollow Metal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>Student Multipurpose</td>
<td>6' - 0&quot;</td>
<td>7' - 0&quot;</td>
<td>0' - 1 3/4&quot;</td>
<td>Wood</td>
<td>D-A</td>
<td>Hollow Metal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>122A</td>
<td>Student Multipurpose</td>
<td>5' - 0&quot;</td>
<td>7' - 0&quot;</td>
<td>Aluminum</td>
<td>D-C</td>
<td>(Pair)</td>
<td></td>
<td></td>
<td></td>
<td>* Verify existing dimensions during bidding</td>
</tr>
<tr>
<td>126</td>
<td>Office</td>
<td>2' - 10&quot;</td>
<td>7' - 0&quot;</td>
<td>0' - 2&quot;</td>
<td>Aluminum</td>
<td>D-C</td>
<td></td>
<td></td>
<td></td>
<td>* Verify existing dimensions during bidding</td>
</tr>
</tbody>
</table>
New 1" insulated metal panel
Existing 5/8" type X gypsum board on 3 5/8" metal studs at 12" o.c. anchored to existing plaster ceiling, paint gypsum board

New 2'x2' lay-in acoustic ceiling

New aluminum storefront with 1" glazing or metal panel, Re: Elevations and Section

New cast stone sill, field verify dimensions, anchor to existing slab with dowels and epoxy setting bed

Existing cast stone sill below to remain

1' - 2"

New self-leveling fill, Re: Plan

Existing furring channels and blocking to remain

Existing 2" x 1 1/2" angle in order to install new storefront

1 Exterior Storefront - Section

Existing brick wall to remain

New 5/8" type X gypsum board, align with existing column

New 5/8" type X gypsum board, trim line on existing column

Existing gypsum board partition

New 5/8" type X gypsum board, laminate on existing column (2) 2x6 framing bolted to existing concrete column for new countertop support, each side

Corner bead each side, typical

Caulk each side, typical

Existing cast stone sill to remain

Remove existing 2"x1 1/2" metal studs on each end

Corner bead each corner, typical

Existing concrete wallwash

New 1/2" x 1/2" corner bead, typical

Existing 1/2" plaster board in furring channels and blocking to remain, repaint

Electrical Schedule

Existing channel to remain

Existing steel plate to remain, repaint

Remove portion on existing plaster to install new treated wood blocking to existing channel to anchor storefront

Corner bead each side, typical

Caulk each side, typical

New 0.05 aluminum break metal, remove existing .05 break metal before installing new

New .05 aluminum break metal over new treated wood blocking

New 2 1/2" lay-in acoustic ceiling

New 5/8" type X gypsum board at 3 5/8" metal studs at 12" o.c. anchor to existing plaster ceiling, paint gypsum board

Existing cast stone sill to remain

New cast stone sill

New LVT flooring

Existing 2" concrete sidewalk

New cast stone wall

New LVT flooring

Existing 2" concrete sidewalk

New LVT flooring

Existing 2" concrete sidewalk

New self-leveling fill, Re: Plan

New 2"x2' lay-in acoustic ceiling

Existing channel to remain

Existing steel plate to remain, repaint

Remove portion on existing plaster to install new treated wood blocking to existing channel to anchor storefront

Existing furring channels and blocking to remain

Existing 2" x 1 1/2" angle in order to install new storefront

New 5/8" type X gypsum board, align with existing column

New 5/8" type X gypsum board, trim line on existing column

Existing gypsum board partition

New 5/8" type X gypsum board, laminate on existing column (2) 2x6 framing bolted to existing concrete column for new countertop support, each side

Corner bead each side, typical

Caulk each side, typical

Existing cast stone sill to remain

Remove existing 2"x1 1/2" metal studs on each end

Corner bead each corner, typical

Existing concrete wallwash

New 1/2" x 1/2" corner bead, typical

Existing 1/2" plaster board in furring channels and blocking to remain, repaint

Electrical Schedule

Existing channel to remain

Existing steel plate to remain, repaint

Remove portion on existing plaster to install new treated wood blocking to existing channel to anchor storefront

Corner bead each side, typical

Caulk each side, typical

New 0.05 aluminum break metal, remove existing .05 break metal before installing new

New .05 aluminum break metal over new treated wood blocking

New 2 1/2" lay-in acoustic ceiling

New 5/8" type X gypsum board at 3 5/8" metal studs at 12" o.c. anchor to existing plaster ceiling, paint gypsum board

Existing cast stone sill to remain

New cast stone sill

New LVT flooring

Existing 2" concrete sidewalk

New cast stone wall

New LVT flooring

Existing 2" concrete sidewalk

New LVT flooring

Existing 2" concrete sidewalk

New self-leveling fill, Re: Plan

New 2"x2' lay-in acoustic ceiling

Existing channel to remain

Existing steel plate to remain, repaint

Remove portion on existing plaster to install new treated wood blocking to existing channel to anchor storefront

Corner bead each side, typical

Caulk each side, typical

New 0.05 aluminum break metal, remove existing .05 break metal before installing new

New .05 aluminum break metal over new treated wood blocking

New 2 1/2" lay-in acoustic ceiling

New 5/8" type X gypsum board at 3 5/8" metal studs at 12" o.c. anchor to existing plaster ceiling, paint gypsum board

Existing cast stone sill to remain

New cast stone sill

New LVT flooring

Existing 2" concrete sidewalk

New cast stone wall

New LVT flooring

Existing 2" concrete sidewalk

New self-leveling fill, Re: Plan

New 2"x2' lay-in acoustic ceiling

Existing channel to remain

Existing steel plate to remain, repaint

Remove portion on existing plaster to install new treated wood blocking to existing channel to anchor storefront

Corner bead each side, typical

Caulk each side, typical

New 0.05 aluminum break metal, remove existing .05 break metal before installing new

New .05 aluminum break metal over new treated wood blocking

New 2 1/2" lay-in acoustic ceiling

New 5/8" type X gypsum board at 3 5/8" metal studs at 12" o.c. anchor to existing plaster ceiling, paint gypsum board

Existing cast stone sill to remain

New cast stone sill

New LVT flooring

Existing 2" concrete sidewalk

New cast stone wall

New LVT flooring

Existing 2" concrete sidewalk
### Lighting Fixture Schedule

<table>
<thead>
<tr>
<th>MAKE</th>
<th>MANUFACTURER</th>
<th>CATALOG NO.</th>
<th>LAMP</th>
<th>WTL.</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>GENERAL</td>
<td>202-5461-01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>GENERAL</td>
<td>202-5461-02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>GENERAL</td>
<td>202-5461-03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>GENERAL</td>
<td>202-5461-04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>GENERAL</td>
<td>202-5461-05</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Electrical Symbols

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBD</td>
<td>LED Downlight</td>
</tr>
<tr>
<td>LTM</td>
<td>LED Track Light</td>
</tr>
<tr>
<td>LM</td>
<td>LED Module</td>
</tr>
<tr>
<td>LNS</td>
<td>LED Strip Light</td>
</tr>
<tr>
<td>L5</td>
<td>LED Linear Light</td>
</tr>
<tr>
<td>E1</td>
<td>Electrical Equipment</td>
</tr>
</tbody>
</table>

### Panelboard and Feeder Schedule

<table>
<thead>
<tr>
<th>MAKE</th>
<th>MAKE 1</th>
<th>BRANCH</th>
<th>BRANCH SEL.</th>
<th>BRANCH SIZE</th>
<th>FEEDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Switch all lights per the installation instructions.