TOWN OF MONROE

REQUEST FOR PROPOSALS

RFP #2024-03, 2024
TITLE: ADDITIONS AND RENOVATIONS TO THE MONROE ANIMAL SHELTER
DEPARTMENT: PUBLIC WORKS
RELEASE TIME: JULY 22, 2024
RESPONSE DEADLINE: AUGUST 14, 2024 10:00 A.M.

PROCEDURAL INQUIRIES:

OFFICE OF THE FIRST SELECTMAN
7 FAN HILL ROAD
MONROE, CT 06468
(203) 452-2821
FirstSelectman@monroect.gov

TOWN OF MONROE, CONNECTICUT
ADDITIONAL RENOVATIONS TO THE MONROE ANIMAL SHELTER
RFP # 2024-03

LEGAL NOTICE

INVITATION TO BID

TOWN OF MONROE, CONNECTICUT

REQUEST FOR PROPOSALS

ADDITIONS AND RENOVATIONS TO THE MONROE ANIMAL SHELTER

JULY 22, 2024

The Town of Monroe ("Town") invites sealed proposals from qualified Contractors through **August 14, 2024 10:00 A.M.**

The documents comprising the Request for Proposals may be obtained electronically at: https://portal.ct.gov/das/ctsource/bidboard?language=en_US and the Town of Monroe website https://www.monroect.gov/p/local-notices under 'New & Announcements'.

The Town hereby reserves the right to amend or terminate this Request for Proposals, accept all or any part of a proposal, reject all proposals, waive any informalities or non-material deficiencies in a proposal, and award the contract to the lowest proposal that meets the criteria set forth in the Request for Proposal and as may be in the best interests of the Town in its discretion. No right shall accrue to any person submitting a bid until such bids have been accepted and contract awarded in writing by the duly authorized representative of the Town. The Town reserves the right to reject any and all bids and to accept the lowest responsible Bidder, and to waive any informalities, omissions, excess verbiage, or technical defects in the bidding, if, in the opinion of the Town, it would be in their best interest to do so.

REQUEST FOR PROPOSALS
FOR
RENOVATIONS TO ANIMAL CONTROL FACILITY
RFP#2024-03

Proposal Closing Date/Time: AUGUST 14 ,2024 at 10:00a.m.

Proposal Opening Place: Monroe Town Hall, Office of the First Selectman, Room 204, 7 Fan Hill Road, Monroe, CT 06468.

NOTICE: Pursuant to C.G.S. 1-210 (b)(24), the Town reserves the right to exempt responses to this RFP, and all records in connection with the contract award process, until such contract is executed or negotiations for the award of such contract have ended, whichever occurs earlier, provided the First Selectman determines and certifies that the public interest in the disclosure of such responses, record or file is outweighed by the public interest in the confidentiality of such responses, record or file.

The Town of Monroe ("Town") is accepting proposals from qualified Contractor ("BIDDER") for the following project/service ("Work"):

ADDITIONS AND RENOVATIONS TO THE MONROE ANIMAL SHELTER

Submission of one (1) original, two (2) hard copies and one (1) electronic copy on a USB drive of sealed proposals must be received at the Monroe Town Hall, Office of the First Selectman, 7 Fan Hill Road, Monroe, CT 06468 not later than the Response Deadline noted above, time being of the essence. The Town will not accept oral, telephone, telegraphic, facsimile or e-mail submissions. The Town will not accept proposals received after the date and time noted above. Postmarks prior to the opening date and time do not satisfy this condition. Bidders are solely responsible for ensuring timely delivery. Proposals are considered valid, and may not be withdrawn, cancelled or modified, for sixty (60) calendar days after the opening date.

The documents comprising the Request for Proposals may be obtained electronically at: https://portal.ct.gov/das/ctsource/bidboard?language=en_US and the Town of Monroe website https://www.monroect.gov/p/local-notices under 'New & Announcements'.

Bidders shall be responsible for checking the website above to determine if the Town has issued any addenda to this RFP and, if so, to complete its Proposal in accordance with the RFP as modified by the addenda.

The Town hereby reserves the right to amend or terminate this Request for Proposals, accept all or any part of a proposal, reject all proposals, waive any informalities or non-material deficiencies in a proposal, award the contract to the lowest responsible Bidder that meets the criteria set forth in the Request for Proposal, and to waive any informalities, omissions, excess verbiage, or technical defects in the bidding, if, in the opinion of the Town, it would be in their best interest to do so.

TOWN OF MONROE, CONNECTICUT
ADDITIONAL RENOVATIONS TO THE MONROE ANIMAL SHELTER
RFP # 2024-03

This Request for Proposals ("RFP") includes:

- Standard Instructions to Bidders
- Required Contract Terms
- Specifications
- Insurance Requirements
- Proposal Form
- Bidder's Legal Status Disclosure Form
- Bidder's Non-Collusion Affidavit Form
- Bidder's Statement of References Form
- Addenda, if any
- The Contract in the form attached
- Contract Addenda, if any

STANDARD INSTRUCTIONS TO BIDDERS

1. INTRODUCTION

The Town is accepting proposals from qualified Bidders for the Work as hereinbefore defined. [ADD MORE DETAIL IF NECESSARY OR DESIRED FOR CLARITY].

This RFP is not a contract offer, and **no contract will exist unless and until a written contract (the "Contract") is signed by the Town and the successful Bidder**.

Interested parties should submit a proposal in accordance with the requirements and directions contained in this RFP. **Bidders are prohibited from contacting any Town employee, officer or official concerning this RFP, except as set forth in Section 6, below. A Bidder's failure to comply with this requirement may result in disqualification.**

Except as otherwise provided in the Contract, if there are any conflicts between the provisions of these Standard Instructions to Bidders and any other documents comprising this RFP, these Standard Instructions to Bidders shall prevail.

2. RIGHT TO AMEND OR TERMINATE THE RFP OR CONTRACT

The Town may, before or after proposal opening and in its sole discretion, clarify, modify, amend or terminate this RFP if the Town determines it is in the Town's best interest. Any such action shall occur by a posting on https://portal.ct.gov/das/ctsource/bidboard?language=en_US, and the Town of Monroe website https://www.monroect.gov/p/local-notices under 'New & Announcements'.
Bidders shall be responsible for checking website above determine if the Town has issued any addenda to this RFP and, if so, to complete its Proposal in accordance with the RFP as modified by the addenda.

If this RFP provides for a multi-year Contract, the Town also reserves the right to terminate the Contract in subsequent years in the event that the Town declines to appropriate sufficient funds. The Town shall have no obligation or liability to the successful Bidder for any unfunded year or years.

3. KEY DATES

ADVERTISED: July 22,2024
MANDATORY Pre-Proposal Conference: July 31, 2024 at 11:00 a.m.
Interviews: To be determined; see Section 21
Preliminary Notice of Award: Within 60 days of Proposal
Opening: August 14, 10:00 a.m. Rm 204 Town Hall
Contract Execution: Within 10 days of Preliminary Notice of Award

The Interviews, Preliminary Notice of Award and Contract Execution dates are anticipated, notcertain, dates.

4. OBTAINING THE RFP

The documents comprising the Request for Proposals may be obtained electronically at: https://portal.ct.gov/das/ctsource/bidboard?language=en_US and the Town of Monroe website https://www.monroect.gov/p/local-notices under 'New & Announcements'.

5. PROPOSAL SUBMISSION INSTRUCTIONS

Proposals must be received in the Monroe Town Hall, Office of the First Selectman, 7 Fan Hill Road, Monroe, CT 06468 prior to Response Deadline, time being of the essence. The Town will not accept oral, telephone, telegraphic, facsimile or e-mail submissions. or fax. The Town will not accept proposals received after the date and time noted above. Postmarks prior to the opening date and time do not satisfy this condition. Bidders are solely responsible for ensuring timely delivery. No submissions may be accepted or withdrawn after the Response Deadline.

One (1) original, two (2) hard copies and one (1) electronic copy on a USB drive of sealed proposals of all proposal documents must be submitted in sealed, opaque envelopes clearly labeled with the Bidder's name, the Bidder's address, the words **"PROPOSAL DOCUMENTS," ** and the **RFP Title, RFP Number and Release Date and Time**. The Town may decline to accept proposals submitted in unmarked envelopes that the Town opens in its normal course of business. The Town may, but shall not be required to, return such proposal documents, and inform the Bidder that the proposal documents may be resubmitted in a sealed envelope properly marked as described above.

Proposal prices must be submitted on the Proposal Form included in this RFP. All blank spaces for proposal prices must be completed in ink or be typewritten; proposal prices must be stated in both words and figures. The person signing the Proposal Form must initial any errors, alterations, or corrections on that form. Ditto marks or words such as "SAME" shall not be used in the Proposal Form.

Proposals may be withdrawn personally or in writing provided that the Town receives the withdrawal prior to the date and time the proposals are scheduled to be opened. Proposals are considered valid, and may not be withdrawn, cancelled, or modified, for sixty (60) calendar days after the opening date, in order to give the Town sufficient time to review the proposals, investigate the Bidders' qualifications, secure any required municipal approvals, and execute a binding contract with the successful Bidder.

An authorized person representing the legal entity of the Bidder must sign the Proposal Form and all other forms included in this RFP.

6. QUESTIONS AND AMENDMENTS

Questions concerning the process and procedures applicable to this RFP are to be submitted **only in writing** (including by e-mail) and directed **only to**:

Department: Office of the First Selectman
E-mail: FirstSelectman@monroect.gov

Questions concerning this RFP's Specifications are to be submitted **only in writing** (including by e-mail) and directed **only to**:

Name: Chris Nowacki
Department: Public Works
E-mail: cnowacki@monroect.gov

Bidders are prohibited from contacting any other Town employee, officer or officialconcerning this RFP. A Bidder's failure to comply with this requirement may result in disqualification.

7. ADDITIONAL INFORMATION

The Town reserves the right, either before or after the opening of proposals, to communicate with any Bidder to clarify its proposal or to submit additional information that the Town in its sole discretion deems desirable.

8. COSTS FOR PREPARING PROPOSAL

Each Bidder's costs incurred in developing its proposal are its sole responsibility, and the Town shall have no liability for such costs.

9. OWNERSHIP OF PROPOSALS

All proposals submitted become the Town's property and shall not be returned to Bidders.

10. FREEDOM OF INFORMATION ACT

All information submitted in a proposal or in response to a request for additional information is subject to disclosure under the Connecticut Freedom of Information Act as amended and judicially interpreted. A Bidder's responses may contain financial, trade secret or other data that it claims should not be public (the "Confidential Information"). A Bidder must identify specifically the pages and portions of its proposal or additional information that contain the claimed Confidential Information by visibly marking all such pages and portions. Provided that the Bidder cooperates with the Town as described in this section, the Town shall, to the extent permitted by law, protect from unauthorized disclosure such Confidential Information.

If the Town receives a request for a Bidder's Confidential Information, it will promptly notify the Bidder in writing of such request and provide the Bidder with a copy of any written disclosure request. The Bidder may provide written consent to the disclosure or may object to the disclosure by notifying the Town in writing to withhold disclosure of the information, identifying in the notice the basis for its objection, including the statutory exemption(s) from disclosure. The Bidder shall be responsible for defending any complaint brought in connection with the nondisclosure, including but not only appearing before the Freedom of Information Commission, and providing

witnesses and documents as appropriate.

11. REQUIRED DISCLOSURES

Each Bidder must, in its Proposal Form, make the disclosures set forth in that form. A Bidder's acceptability based on those disclosures lies solely in the Town's discretion.

12. REFERENCES

Each Bidder must complete and submit the Bidder's Statement of References Form includedin this RFP.

13. LEGAL STATUS

If a Bidder is a corporation, limited liability company, or other business entity that is required to register with the Connecticut Secretary of the State's Office, it must be registered and in good standing with that office. The Town may, in its sole discretion, request acceptable evidence of any Bidder's legal status. Each Bidder must complete the Bidder's Legal Status Disclosure Form included in this RFP.

14. PROPOSAL SECURITY/BOND

$5000.00

15. PRESUMPTION OF BIDDER'S FULL KNOWLEDGE

Each Bidder is responsible for having read and understood each document in this RFP and any addenda issued by the Town. A Bidder's failure to have reviewed all information that is part of or applicable to this RFP, including but not limited to any addenda posted on the Town's website, shall in no way relieve it from any aspect of its proposal or the obligations related thereto.

Each Bidder is deemed to be familiar with and is required to comply with all federal, state and local laws, regulations, ordinances, codes and orders that in any manner relate to this RFP or the provision or goods or performance of the work described herein.

By submitting a proposal, each Bidder represents that it has thoroughly examined and become familiar with the scope of work outlined/the goods described in this RFP, and it is capable of performing the work/delivering/installing the goods to achieve the Town's objectives. If applicable, each Bidder shall visit the site, examine the areas, and thoroughly familiarize itself with all conditions of the property before preparing its proposal.

16. TAX EXEMPTIONS

The Town is exempt from the payment of federal excise taxes and Connecticut sales and use taxesper Federal Tax Exempt #06-6002038 and pursuant to Conn. Gen. Stat. Chapter 219, § 12-

412(1), as may be hereafter amended.

17. INSURANCE

The successful Bidder shall, at its own expense and cost, obtain and keep in force at least the insurance listed in the Insurance Requirements that are a part of this RFP. The Town reserves the right to request from the successful Bidder a complete, certified copy of each required insurance policy.

18. PERFORMANCE SECURITY/BOND

The Contractor shall furnish performance and payment bonds , each in the amount at least equal to the Contract Price as security for the faithful performance and payment of all Contractors obligations under the contract documents.

19. AWARD CRITERIA; PRELIMINARY SELECTION; CONTRACT EXECUTION

The Town reserves the right to correct, after Bidder verification, any mistake in a proposal that is a clerical or scrivener's error. If an error exists in an extension of prices, the unit price shall prevail. In the event of a discrepancy between the price quoted in words and in figures, the words shall control.

The Town hereby reserves the right to amend or terminate this Request for Proposals, accept all or any part of a proposal, reject all proposals, waive any informalities or non-material deficiencies in a proposal, award the contract to the lowest responsible Bidder that meets the criteria set forth in the Request for Proposal, and to waive any informalities, omissions, excess verbiage, or technical defects in the bidding, if, in the opinion of the Town, it would be in their best interest to do so. The Town also reserves the right, if applicable, to award the purchase of individual items under this RFP to any combination of separate proposals or Bidders.

The proposals will be evaluated by a Review Committee ("Committee") which will select the proposal that meets the criteria set forth in the RFP and is in the best interests of the Town, including without limitation, the cost of the proposal, the Bidder's understanding of the RFP requirements, approach and timeline; the Bidder's locale of its offices and personnel and staffing, and the Bidder's personnel and staffing, resources, experience, references, capabilities, past performance, and other relevant criteria. The Town may reject any Bidder if, in the sole judgment of the Town, the Bidder's past performance gives rise to a substantial risk that the Bidder may not provide satisfactory performance. The Town reserves the right to pursue or reject any and all proposals, in whole or in part, to give preference to local businesses, and to pursue any proposal deemed to be in the best interests of the Town. The Town is not under any obligation to award to the lowest priced response. The Town shall reserve rights to amend or to terminate the RFP at its sole discretion, and at any time.

If interviews are deemed necessary, a short list of Bidders will be developed and specific information required for the interviews will be provided to Bidders at the time of notification. Generally, interviews are 30-45 minutes long; initial presentations are typically limited to 15

minutes and final 15-30 minutes are reserved for questions and subsequent discussion. The key person to be assigned to this project must be present at this interview.

The Town shall not award the proposal to any business that, or person who, is in arrears or in default to the Town with regard to any tax, debt, contract, security or any other obligation.

The Town will issue a Preliminary Notice of Award. The preliminary notice of award may be subject to further negotiations with the Bidder. **The making of a preliminary award to a Bidder does not provide the Bidder with any rights and does not impose upon the Town any obligations. The Town is free to withdraw a preliminary award at any time and for any reason. A Bidder has rights, and the Town has obligations, only if and when a Contract is executed by the Town and the Bidder.**

If the Bidder does not provide all required documents and execute the Contract within ten (10) business days of the date of the Preliminary Notice of Award, unless extended by the Town, the Town may call any proposal security provided by the Bidder and may enter into discussions with another Bidder.

The Interviews, Preliminary Notice of Award and Contract Execution dates as provided in Section 3, Key Dates, are anticipated, not certain, dates.

20. BIDDER REPRESENTATIONS

In presenting a proposal pursuant to this RFP, the Bidder represents that: it understands the requirements of this RFP and the Work for which the proposal is submitted; the proposal is based upon the services, materials, equipment and systems required by this RFP without exception or qualification, except as expressly stated in the proposal; it is familiar with local conditions under which the services are to be performed and has correlated the Bidder's personal observations with the requirements of this RFP; it has not colluded with any other person in regard to any proposal submitted; it is not barred from proposing or performing work in any jurisdiction; and, the proposal is made in full conformance with this RFP.

21. COMPLIANCE WITH IMMIGRATION LAWS

By submitting a proposal, each Bidder confirms that it has complied, and during the term of the Contract will comply, with the Immigration Reform and Control Act ("IRCA") and that each person it provides under the Contract will at all times be authorized for employment in the United States of America. Each Bidder confirms that it has a properly completed Employment Eligibility Verification, Form I-9, for each person who will be assigned under the Contract and that it will require each subcontractor, if any, to confirm that it has a properly completed Form I-9 for each person who will be assigned under the Contract. The successful Bidder shall defend, indemnify, and hold harmless the Town, its employees, officers, officials, agents, volunteers and independent

contractors, including any of the foregoing sued as individuals (collectively, the "Town Indemnified Parties"), against any and all proceedings, suits, actions, claims, damages, injuries, awards, judgments, losses or expenses, including fines, penalties, punitive damages, attorney's fees and costs, brought or assessed against,or incurred by, the Town Indemnified Parties related to or arising from the obligations under IRCA imposed upon the successful Bidder or its subcontractor. The successful Bidder shall also be required to pay any and all attorney's fees and costs incurred by the Town Indemnified Parties in enforcing any of the successful Bidder's obligations under this provision, whether or not a lawsuit or other proceeding is commenced. The successful Bidder's obligations under this section shall survive the termination or expiration of the Contract.

22. NON-COLLUSION AFFIDAVIT

Each Bidder shall submit a completed Bidder's Non-Collusion Affidavit Form that is part of this RFP.

END OF STANDARD INSTRUCTIONS TO BIDDERS

REQUIRED CONTRACT TERMS

The following provisions will be mandatory terms of the Town's Contract with the successful Bidder. If a Bidder is unwilling or unable to meet, or seeks to clarify or modify, any of these Contract Terms, the Bidder must disclose that inability, unwillingness, clarification and/or modification in its Proposal Form (see Section 11 of the Standard Instructions to Bidders):

1. DEFENSE, HOLD HARMLESS AND INDEMNIFICATION

The successful Bidder agrees, to the fullest extent permitted by law, to defend, indemnify, and hold harmless the Town, its employees, officers, officials, agents, volunteers and independent contractors, including any of the foregoing sued as individuals (collectively, the "Town Indemnified Parties"), from and against all proceedings, suits, actions, claims, damages, injuries, awards, judgments, losses or expenses, including attorney's fees, arising out of or relating, directly or indirectly, to the successful Bidder's malfeasance, misconduct, negligence or failure to meet its obligations under the RFP or the Contract. The successful Bidder's obligations under this section shall not be limited in any way by any limitation on the amount or type of the successful Bidder's insurance.

In any and all claims against the Town Indemnified Parties made or brought by any employee of the successful Bidder, or anyone directly or indirectly employed or contracted with by the successful Bidder, or anyone for whose acts or omissions the successful Bidder is or may be liable, the successful Bidder's obligations under this section shall not be limited by any limitation on the amount or type of damages, compensation or benefits payable by the successful Bidder under workers' compensation acts, disability benefit acts, or other employee benefits acts.

The successful Bidder shall also be required to pay any and all attorney's fees incurred by the Town Indemnified Parties in enforcing any of the successful Bidder's obligations under this section. The successful Bidder's obligations under this section shall survive the termination or expiration of the Contract.

As a municipal agency of the State of Connecticut, the Town will NOT defend, indemnify, or hold harmless the successful Bidder.

2. NO ASSIGNMENT; SUBCONTRACTING

The successful Bidder may not subcontract, transfer or assign any of its obligations under the Contract except as follows:

Prior to entering into any subcontract agreement(s) for the work described in the Contract, the successful Bidder shall provide the Town with written notice of the identity (full legal name, street address, mailing address (if different from street address), and telephone number) of each proposed subcontractor. The Town shall have the right to object to any proposed subcontractor byproviding the successful Bidder with written notice thereof within seven (7) business days of receipt of all required information about the proposed subcontractor. If the Town objects to a

proposed subcontractor, the successful Bidder shall not use that subcontractor for any portion of the work described in the Contract.

All permitted subcontracting shall be subject to the same terms and conditions as are applicable to the successful Bidder. **The successful Bidder shall remain fully and solely liable and responsible to the Town for performance of the work described in the Contract.** The successful Bidder also agrees to promptly pay each of its subcontractors within thirty (30) days of receipt of payment from the Town or otherwise in accordance with law. The successfulBidder shall assure compliance with all requirements of the Contract. The successful Bidder shall also be fully and solely responsible to the Town for the acts and omissions of its subcontractors and of persons employed, whether directly or indirectly, by its subcontractor(s).

3. W-9 FORM

The successful Bidder must provide the Town with a completed W-9 form before Contract execution.

4. GENERAL PROVISIONS CONCERNING PAYMENTS

Except as otherwise noted in the Specifications or Contract, all payments are to be made thirty (30) days after the appropriate Town employee receives and approves the invoice, unless otherwise specified in the Specifications.

5. TOWN INSPECTION OF WORK

The Town may inspect the successful Bidder's work at all reasonable times. This right of inspection is solely for the Town's benefit and does not transfer to the Town the responsibility for discovering patent or latent defects. The successful Bidder has the sole and exclusive responsibility for performing in accordance with the Contract.

6. REJECTED WORK OR MATERIALS

The successful Bidder, at its sole cost and expense, shall remove from the Town's property rejected items, commodities and/or work within forty-eight (48) hours of the Town's notice of rejection. Immediate removal may be required when safety or health issues are present.

7. MAINTENANCE AND AVAILABILITY OF RECORDS

The successful Bidder shall maintain all records related to the work described in the RFP for a period of five (5) years after final payment under the Contract or until all pending Town, state and federal audits are completed, whichever is later. Such records shall be available for examination and audit by Town, state and federal representatives during that time.

8. ADVERTISING

The successful Bidder shall not name the Town in its advertising, news releases, or promotional

efforts without the Town's prior written approval.

If it chooses, the successful Bidder may list the Town in a Statement of References or similar document required as part of its response to a public procurement. The Town's permission to the successful Bidder to do so is not a statement about the quality of the successful Bidder's work or the Town's endorsement of the successful Bidder.

9. PREVAILING WAGES

Required: Utilize the most current State of Connecticut Department of labor rates when preparing bids.

10. PREFERENCES

This item is not applicable to this RFP

11. WORKERS COMPENSATION

The contract requires the Contractor to maintain insurance policies in force during the performance of the Work in accordance with the Supplemental Condition of this Project Manual; including at minimum bodily injury liability insurance, contractors' property damage insurance, Owner's protective liability insurance

Comprehensive automobile liability coverage and workers compensation insurance.

12. SAFETY

As prescribed by OSHA guidelines for appropriate construction activities.

13. NONDISCRIMINATION AND AFFIRMATIVE ACTION

In the performance of the Contract, the successful Bidder will not discriminate or permit discrimination in any manner prohibited by the laws of the United States or of the State of Connecticut against any person or group of persons on the grounds of race, color, religious creed, age (except minimum age), marital status or civil union status, national origin, ancestry, sex, sexual orientation, gender identity, mental retardation, mental disability or physical disability, including but not limited to blindness, unless the successful Bidder shows that such disability prevents performance of the work involved.

In the performance of the Contract, the successful Bidder will take affirmative action to insure that applicants with job-related qualifications are employed and that employees are treated when employed without regard to their race, color, religious creed, age (except minimum age), marital status or civil union status, national origin, ancestry, sex, sexual orientation, gender identity, mental retardation, mental disability or physical disability, including but not limited to blindness, unless the successful Bidder shows that such disability prevents performance of the work involved.

The successful Bidder shall comply with all provisions of federal and state discrimination laws

including without limitation, the Civil Rights Act of 1964 and the Equal Employment Opportunity Act of 1972.

Any violation of these provisions shall be considered a material violation of the Contract and shall be grounds for the Town's cancellation, termination or suspension, in whole or in part, of the Contract and may result in ineligibility for further Town contracts.

14. STATE GRANT/LOAN AGREEMENT

Connecticut Department of Agriculture STEAP Grant.

15. SUCCESSFUL BIDDER PERSONNEL MUST BE AUTHORIZED TO WORK

The Successful Bidder confirms that it has complied with the obligations under the Immigration Reform and Control Act (IRCA) and that the employees, independent contractors and other personnel it provides under this Contract are authorized for employment in the United States. The successful Bidder further confirms that it has properly completed I-9s for all employees assigned to the Town's place of business. The successful Bidder agrees to hold harmless and indemnify the Town in the event that any of the employees or other personnel provided by the successful Bidder are found not to be authorized to work under the law or in the event that there is a determination that the obligations set forth under IRCA, including, but not limited to, the failure tocorrectly prepare and maintain I-9s, have not been complied with by the successful Bidder. The successful Bidder agrees to indemnify, defend and hold the Town harmless against any claims brought against the successful Bidder or the Town as a result of these obligations, including but not limited to, settlement fees, judgments and attorneys' fees and costs.

16. CESSATION OF BUSINESS/BANKRUPTCY/RECEIVERSHIP

If the successful Bidder ceases to exist, dissolves as a business entity, ceases to operate, files a petition or proceeding under any bankruptcy or insolvency laws or has such a petition or proceeding filed against it, the Town has the right to terminate the Contract effective immediately. In that event, the Town reserves the right, in its sole discretion as it deems appropriate and without prior notice to the successful Bidder, to make arrangements with another person or business entity to provide the services described in the Contract and to exercise any or all of its rights at Law, in equity, and/or under the Contract.

17. NON-EMPLOYMENT RELATIONSHIP

The Town and the successful Bidder are independent parties. Nothing contained in the Contract shall create, or be construed or deemed as creating, the relationships of principal and agent, partnership, joint venture, employer and employee, and/or any relationship other than that of independent parties contracting with each other solely for the purpose of carrying out the termsand conditions of the Contract. The successful Bidder understands and agrees that it is not entitled to employee benefits, including but not limited to workers compensation and employment insurance coverage, and disability. The successful Bidder shall be solely responsible for any applicable taxes.

18. VALIDITY

The invalidity of one or more of the phrases, sentences or clauses contained in the Contract shall not affect the remaining portions so long as the material purposes of the Contract can be determined and effectuated.

19. COMPLIANCE WITH LAWS; PERMITS

The successful Bidder shall comply with all applicable laws, regulations, ordinances, codes and orders of all governmental bodies, including the United States, the State of Connecticut and the Town, related to its proposal and the performance of the Contract. The successful Bidder shall also, at its own expense, obtain all permits and approvals from all such governmental bodies required for performance of the Contract, and shall immediately notify the Town in writing of the loss or suspension of any such approval or permit.

20. CONNECTICUT LAW AND COURTS

The Contract shall be governed by and construed in accordance with the internal laws (as opposed to the conflicts of law provisions) of the State of Connecticut, and the parties irrevocably submit in any suit, action or proceeding arising out of the Contract to the jurisdiction of the United States District Court for the District of Connecticut or of any court of the State of Connecticut, as applicable.

END OF REQUIRED CONTRACT TERMS

PROPOSAL INFORMATION REQUIRED

Proposals shall contain the following information, without limitation:

- Cover / introductory letter
- Size, history and organizational structure of firm (Limit to 1 page)
- Resume of key personnel that would work on the study. (Limit to 1 page per resume)
- Approach to the Work:
- A narrative relating to your general approach to this Work.
- Describe additional tasks that could be valuable to the Work.
- Provide a description of similar projects performed by the firm that incorporated elements of the scope of Work.
- Provide client references for such projects.
- List of subcontractors that will be utilized for the Work, including resumes of subcontractor project personnel.
- Any Additional information or materials that you believe communicate the capabilities of your firm to perform the Work.
- Anticipated schedule and milestones.
- Fees for your services. The Town requires that a maximum fee for the service be provided in response to this RFP but will additionally consider alternative fee structures.
- If your firm has been a party to arbitration, mediation, or litigation involving (a) any matter with the Town of Monroe or (b) with any other party regarding a similar project, state the identity of the customer, the nature of the proceedings, when and where the proceedings occurred, and any official file number or other identifier. Also state a summary of the issues and the results of the proceedings.
- The Bidder must disclose in writing any exceptions to the RFP and their proposal shall have no exceptions to this requirement. The exceptions to the RFP shall include, but not be limited to:
- Inability or unwillingness to meet any requirements of the RFP
- Proposal Form (including fee proposal) in a separate sealed envelope
- Bidder's Legal Status Disclosure
- Bidder's Non-Collusion Affidavit Form
- Bidder's Statement of References Form

The Town of Monroe reserves the right to reject any or all responses submitted or may request additional information from any firm as necessary to properly evaluate the responses.

END OF SPECIFICATIONS

INSURANCE REQUIREMENTS

a. Commercial General Liability: $1,000,000
Combined single limits per occurrence for bodily injury, personal injury, property damage and products/completed operations.

1. The Town and its respective officers, agents, officials, employee volunteers, boards and commissions are to be covered as insured as respects: liability arising out of activities performed by or on behalf of the contractor; products and completed operations of the contractor; premises owned, leased or used by the contractor. Thecoverage shall contain no special limitations on the scope of protection afforded to the Town.
2. The contractor's insurance coverage shall be primary insurance as respects the Town of Monroe. Any insurance or self-insurance maintained by the Town shall beexcess of the contractor's insurance and shall not contribute with it.
3. Any failure to comply with reporting provisions of the policies shall not affect coverages provided to the Town of Monroe.
4. Coverage shall state that the contractor's insurance shall apply separately to eachinsured against whom claim is made or suit is brought, except with respect to thelimits of the insurer's liability.

b. Automobile Liability:
Each Accident: $1,000,000
Hired/Non-owned Auto Liability $1,000,000

c. Errors and Omissions/Professional Liability Insurance [$1,000,000 or N/A]

- If issued on a claims-made basis, the policy must remain in effect for the duration of the contract and two (2) years after project completion. An extension of three (3) additional years may be required at the discretion of the Town Manager or his/her designee.
- For all professional contracts - liability policies may not be limited to the fees paid to the vendor.

d. Worker's Compensation, as required by law.

e. The "Town of Monroe" is to appear as an additional insured on the contractor's general liability and automobile liability Certificates of Insurance.

f. All insurance is to be provided by a company authorized to issue such insurance in the State of Connecticut with a Best rating of no less than A- .

g. The contractor shall furnish the Town with certificates of insurance effecting coverage required by this clause. The certificates and endorsements for each insurance policy are tobe signed by a person authorized by that insurer to bind coverage on its behalf. The certificates and endorsements are to be received and approved by the Town before work commences. Renewal of expiring certificates shall be filed thirty (30) days prior to expiration. The Town reserves the right to require complete, certified copies of all required policies, at any time.

h. It is desired by the Town that no insurance be suspended, voided, canceled or modified incoverage or limits without thirty (30) days prior written notice be registered U.S. Mail to:Town of Monroe, Office of the First Selectman, 7 Fan Hill Road, Monroe, CT 06468.

PROPOSAL FORM

We agree to perform the work described in the bid documents (Front End, Drawings and Specifications, and addendums (if any) for a **TOTAL BASE BID amount.** $_____.

$_____
Written dollar amount

Acknowledgement of Addendum (if any)
_____#1 _____#2 _____#3

ACKNOWLEDGEMENT

In submitting this Proposal Form, the undersigned Bidder acknowledges that the price(s) include all labor, materials, transportation, hauling, overhead, fees and insurances, bonds or letters of credit, profit, security, permits and licenses, and all other costs to cover the completed products and/or services called for in the RFP. Except as otherwise expressly stated in the RFP, no additional payment of any kind will be made for the products and/or services called for in the RFP.

REQUIRED DISCLOSURES

1. Exceptions to/Clarifications of/Modifications of the RFP

_____ This proposal does not take exception to or seek to clarify or modify any requirement of the RFP, including but not only any of the Required Contract Terms as set forth in this RFP. **The Bidder agrees to each and every requirement, term, provision and condition of this RFP**.

OR

_____ This proposal takes exception(s) to and/or seeks to clarify or modify certain RFP requirements, including the Required Contract Terms. **Attached is a sheet fully describing each such exception.**

2. State Debarment List

Is the Bidder on the State of Connecticut's Debarment List?

_____ Yes _____ No

3. Occupational Safety and Health Law Violations

Has the Bidder or any firm, corporation, partnership or association in which it

has an interest (1) been cited for three (3) or more willful or serious violations of any occupational safety and health act or of any standard, order or regulation promulgated pursuant to such act, during the three-year period preceding the proposal (provided such violations were cited in accordance with the provisions of any state occupational safety and health act or the Occupational Safety and Health Act of 1970, and not abated within the time fixed by the citation and such citation has not been set aside following appeal to the appropriate agency or court having jurisdiction) or (2) received one or more criminal convictions related to the injury or death of any employee in the three-year period preceding the proposal?

_____ Yes _____ No

If "yes," attach a sheet fully describing each such matter.

4. Arbitration/Litigation

Has either the Bidder or any of its principals (regardless of place of employment) been involved for the most recent ten (10) years in any pending or resolved arbitration or litigation?

_____ Yes _____ No

If "yes," attach a sheet fully describing each such matter.

5. Criminal Proceedings

Has the Bidder or any of its principals (regardless of place of employment) ever been the subject of any criminal proceedings?

_____ Yes _____ No

If "yes," attach a sheet fully describing each such matter.

6. Ethics and Offenses in Public Projects or Contracts

Has either the Bidder or any of its principals (regardless of place of employment) ever been found to have violated any state or local ethics law, regulation, ordinance, code, policy or standard, or to have committed any other offense arising out of the submission of proposals or bids or the performance of work on public works projects or contracts?

_____ Yes _____ No

If "yes," attach a sheet fully describing each such relationship.

7. No Conflict of Interest

Is the Bidder aware of any personal or business relationship between a Town officer or employee and an officer, director, member, manager or partner of the Bidder that could be regarded as creating a conflict of interest?

_____ Yes _____ No

If "yes," attach a sheet fully describing each such matter.

8. The undersigned is an authorized representative of the Bidder, and hereby acknowledges that the proposal and accompanying documents shall be valid and binding upon the Bidder for a period of not less than one hundred fifty (150) days from the Response Deadline.

_____ Yes _____ No

NOTE: THIS DOCUMENT, IN ORDER TO BE CONSIDERED A VALID PROPOSAL, MUSTBE SIGNED BY A PRINCIPAL OFFICER OR OWNER OF THE BUSINESS ENTITY THATIS SUBMITTING THE PROPOSAL. SUCH SIGNATURE CONSTITUTES THE BIDDER'S REPRESENTATIONS THAT IT HAS READ, UNDERSTOOD AND FULLY ACCEPTED EACH AND EVERY PROVISION OF EACH DOCUMENT COMPROMISING THE RFP,UNLESS AN EXCEPTION IS DESCRIBED ABOVE.

BY_____ TITLE:_____
(PRINT NAME)

_____ DATE:_____
(SIGNATURE)

END OF PROPOSAL FORM

BIDDER'S LEGAL STATUS DISCLOSURE

Please fully complete the applicable section below, attaching a separate sheet if you need additional space.

For purposes of this disclosure, "permanent place of business" means an office continuously maintained, occupied and used by the Bidder's regular employees regularly in attendance to carry on the Bidder's business in the Bidder's own name. An office maintained, occupied and used by a Bidder only for the duration of a contract will not be considered a permanent place of business. An office maintained, occupied and used by a person affiliated with a Bidder will not be considered a permanent place of business of the Bidder.

IF A SOLELY OWNED BUSINESS:

Bidder's Full Legal Name _____

Street Address _____

Mailing Address (if different from Street Address)_____

Owner's Full Legal Name_____

Number of years engaged in business under sole proprietor or trade name _____

Does the Bidder have a "permanent place of business" in Connecticut, as defined above?

_____ Yes _____ No

If yes, please state the full street address (not a post office box) of that"permanent place of business."

_____

IF A CORPORATION:

Bidder's Full Legal Name_____

Street Address _____

Mailing Address (if different from Street Address)_____

Owner's Full Legal Name _____

_____ Number of years engaged in business _____

Names of Current Officers

_____	_____	_____
President	Secretary	Chief Financial Officer

Does the Bidder have a "permanent place of business" in Connecticut, as defined above?

_____ Yes _____ No

If yes, please state the full street address (not a post office box) of that"permanent place of business."

_____

IF A LIMITED LIABILITY COMPANY:

Bidder's Full Legal Name Street _____

Address _____

Mailing Address (if different from Street Address)_____

Owner's Full Legal Name _____

Number of years engaged in business _____

Names of Current Manager(s) and Member(s)

_____	_____
Name & Title (if any)	Residential Address (street only)
_____	_____
Name & Title (if any)	Residential Address (street only)
_____	_____
Name & Title (if any)	Residential Address (street only)
_____	_____
Name & Title (if any)	Residential Address (street only)
_____	_____
Name & Title (if any)	Residential Address (street only)

(Attach additional sheets as necessary)

Does the Bidder have a "permanent place of business" in Connecticut, as defined above?

_____ Yes _____ No

If yes, please state the full street address (not a post office box) of that"permanent place of business."

_____

IF A PARTNERSHIP:

Bidder's Full Legal Name _____

Street Address _____

Mailing Address (if different from Street Address)_____

Owner's Full Legal Name _____

Number of years engaged in business _____

Names of Current Partners

_____	_____
Name & Title (if any)	Residential Address (street only)
_____	_____
Name & Title (if any)	Residential Address (street only)
_____	_____
Name & Title (if any)	Residential Address (street only)

(Attach additional sheets as necessary)

Does the Bidder have a "permanent place of business" in Connecticut, as defined above?

_____ Yes _____ No

If yes, please state the full street address (not a post office box) of that"permanent place of business."

_____

Bidder's Full Legal Name _____

_____
(print) Name and Title of Bidder's Authorized Representative

_____
(signature) Bidder's Representative, Duly Authorized

_____
Date

END OF LEGAL STATUS DISCLOSURE FORM

BIDDER'S NON-COLLUSION AFFIDAVIT

The undersigned Bidder, having fully informed himself/herself/itself regarding the accuracy of the statements made herein, certifies that:

(1) the proposal is genuine; it is not a collusive or sham proposal;
(2) the Bidder developed the proposal independently and submitted it without collusion with, and without any agreement, understanding, communication or planned common course of action with, any other person or entity designed to limit independent competition;
(3) the Bidder, its employees and agents have not communicated the contents of the proposal to any person not an employee or agent of the Bidder and will not communicate the proposal to any such person prior to the official opening of the proposal; and
(4) no elected or appointed official or other officer or employee of the Town of Monroe is directly or indirectly interested in the Bidder's proposal, or in the supplies, materials, equipment, work or labor to which it relates, or in any of the profits thereof.

The undersigned Bidder further certifies that this affidavit is executed for the purpose ofinducing the Town of Monroe to consider its proposal and make an award in accordance therewith.

_____ _____
Legal Name of Bidder (signature)
Bidder's Representative, Duly Authorized

_____
Name of Bidder's Authorized Representative

_____
Title of Bidder's Authorized Representative

_____
Date

Subscribed and sworn to before me this_____day of_____, 202__.

_____
Notary Public
My Commission Expires:

END OF NON-COLLUSION AFFIDAVIT FORM

TOWN OF MONROE, CONNECTICUT
ADDITIONAL RENOVATIONS TO THE MONROE ANIMAL SHELTER
RFP # 2024-03

BIDDER'S STATEMENT OF REFERENCES

Provide at least three (3) references:

1. BUSINESS NAME _____

   ADDRESS _____

   CITY, STATE _____

   TELEPHONE: _____

   INDIVIDUAL CONTACT NAME AND POSITION _____

   _____

2. BUSINESS NAME _____

   ADDRESS _____

   CITY, STATE _____

   TELEPHONE: _____

   INDIVIDUAL CONTACT NAME AND POSITION _____

   _____

3. BUSINESS NAME _____

   ADDRESS _____

   CITY, STATE _____

   TELEPHONE: _____

   INDIVIDUAL CONTACT NAME AND POSITION _____

   _____

END OF STATEMENT OF REFERENCES

CONTRACT

This_____Contract (the "Contract") is entered into the_____day of_____, 20__ ("Effective Date") by and between the Town of Monroe, a political subdivision of the State ofConnecticut, (the "Town") and_____, a_____, whose principal office is located at_____,_____(the "Contractor").

WHEREAS, the Town has issued a Request for Proposals (the "RFP") for _____ (the "Work"); and

WHEREAS, Contractor submitted a Proposal to the Town, dated_____, 20___ (the "Proposal"); and

WHEREAS, the Town has selected Contractor and the Town and the Contractor desire to enter into a formal agreement for the performance of the Work;

THEREFORE, in consideration of the recitals set forth above and the mutual promises by the parties below, the parties agree as follows:

1. General. The Contractor agrees to perform the Work in accordance with the Contract Documents, as defined in Section 2 below.

2. Contract Documents. The Contract Documents include the following:

(i) The Contract;
(ii) The RFP, including the Standard Instructions to Bidders, Required Contract Terms, and Specifications;
(iii) Addenda issued prior to the execution of this Contact or modifications issued after the execution of this Contract; and
(iv) The Proposal submitted by the Contractor.

In the event of a conflict or inconsistency between or among the Contract, the RFP and/or theProposal, this Contract shall have the highest priority, the RFP the second priority, and the Proposal the third priority.

3. Incorporation of Required Contract Terms. Without limiting the foregoing**, this Contract incorporates by reference all of the Required Contract Terms set forth in the RFP**, which shall be deemed as fully a part of this Contract as if they were set forth in theirentirety in this Contract.

4. Term of Contract; Commencement of Work. Unless earlier terminated as provided in Section 6 below, the term of the Contract shall commence on the Effective Date of the Contract and be in effect until_____. However, the Contractor shall not start the Work prior to having received a notification to proceed from the Town.

5. Contract Payments. The Town will pay the Contractor for work completed in accordance with Section 4 of the Required Contract Terms of the RFP and the Price Proposal contained in the Proposal Form of the RFP.

6. Failure to Perform by Contractor. If the Contractor fails to perform this Contract in accordance with its terms, the Town shall have the right, in addition to all other remedies it may have, to declare the Contract in default and enter into an agreement with another person to perform the Work. In that event, the Contractor shall pay the Town, as liquidated damages, the amount of any excess of the new price over the price in the Contract Documents, both pro-rated to the period of time covered by the unexpired term of the Contract at the time of default, plus any legal or other costs incurred by the Town in terminating the Contract and securing a new contractor.

7. Change Orders, Price Modifications, and Other Amendments. The Town shall have the right to require the Contractor to make alterations of, additions to and deductions from the Work. All such changes to the Scope of Work shall be made by a written change order written by the Town. The Contractor shall compute the effect of the change order upon the Contract price, subject to review and acceptance by the Town.

8. Notice. All notices, demands, or other documents required or desired to be given, made or sent to either party under this Contract shall be made in writing, shall be deemed effective upon receipt and shall be delivered personally, mailed postage prepaid, certified mail, return receipt requested, as set forth below, which addresses may be changed by written notice given to the other party in the manner provided above.

TO THE TOWN:
Terrence P. Rooney
First Selectman
Town of Monroe
7 Fan Hill Road
Monroe, CT 06468

WITH COPY TO:
Bill Phillips
Deputy Director of Public works
& Fan Hill Road
Monroe, CT 06468

TO CONTRACTOR:
[CONTRACTOR]
[ADDRESS]

9. Entire Contract. The Contract Documents represent the entire and integrated agreement between the Town and the Contractor and supersede all prior negotiations, representations or agreements, whether written or oral.

10. Amendments. The Contract may not be altered or amended except by a written

agreement executed by both parties.

11. Execution. The Contract may be executed in one or more counterparts, each of which shall be considered an original instrument, but all of which shall be considered one and the same agreement. The Contract shall become binding when one or more counterparts have been signed by each of the parties hereto and delivered (including delivery by facsimile or other electronic means) to each of the parties.

IN WITNESS WHEREOF, the Parties have executed this Contract as of the day and year first written above.

THE TOWN OF MONROE

_____ By _____
[Witness] Terrence P. Rooney
First Selectman

[COMPANY NAME]

_____ By _____
[Witness] Its _____

THE TOWN OF MONROE

ADDITIONS AND RENOVATIONS

TO THE

MONROE ANIMAL SHELTER

447 PURDY HILL ROAD

MONROE CONNECTICUT 06438

Construction Document Submission

May 29, 2024

Salamone and Associates, P.C.
Consulting Engineers
116 North Plains Industrial Road
Wallingford Connecticut 06492

Architectural Consultant

Wojas.Arch, LLC
5 Race Track Hollow
Middlefield Connecticut 06455

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 22.

B. Related sections, Division 23 'Common Work Results for HVAC'.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for plumbing installations.
   1. Codes & standards.
   2. Submittals.
   3. Quality control.
   4. Permits, fees, and inspections.
   5. Schedule and sequence.
   6. Project and site conditions.
   7. Delivery, storage, and handling.
   8. Record documents.
   9. Operation and Maintenance manuals.
   10. Warranties and guaranties.
   11. Rough-ins.
   12. Plumbing installations.
   13. Cutting, patching, and firestopping.
   14. Plumbing indentification.
   15. Training.

1.3 SUBMITTALS

A. Increase, by the quantity listed below, the number of plumbing related shop drawings, product data, and samples submitted, to allow for required distribution.

   1. Shop Drawings: Initial Submittal: 1 additional blue- prints.
   2. Product Data: 1 additional copy of each item.
   3. Samples: 1 addition as set.

B. Additional copies may be required by individual sections of these Specifications.

C. Shop Drawings:
   1. Submit for review, detailed shop drawings and product data of all the equipment and material required to complete the work. No material or equipment may be delivered to the jobsite or installed until accepted shop drawings for the particular material or equipment have been approved by the Owner or his authorized representative.
   2. Failure to submit shop drawings in ample time for checking will not entitle Contractor to claim extension of Contract time, or increase in contract cost.
   3. Pproposed piping layout for water distribution piping.
   4. Pproposed piping layout for sanitary waste and vent piping.

D. Tests & Certificates:
   1. As specified in other sections.

1.4 QUALITY ASSURANCE

A. Drawings:
   1. Drawings are diagrammatic. They indicate the general arrangement of systems and work included in the contract. Drawings are not to be scaled. Site and Architectural drawings and details shall be examined for exact location of fixtures and equipment. Where they are not definitely located, this information shall be obtained from the Owner or authorized representative.
   2. Surveys and Measurements:
      a. Before submitting bid, visit site, become familiar with conditions under which work will be installed. Contractor will be held responsible for assumptions, omissions, and errors made as a result of failure to become familiar with site and contract documents.
      b. Base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with established lines and levels. Verify all measurements at site and check the correctness of same.
      c. Notify the Engineer promptly of discrepancies between actual measurements and those indicated, which prevents following good practice or intent of drawings and specifications. Do not proceed with work until Contractor has received instructions from Engineer.

B. Labor:
   1. Coordinate with all other Trades:
      a. Give full cooperation to other trades; furnish in writing to General Contractor, with copies to the Engineer, information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
      b. Where work will be installed in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment. If directed by the Engineer, prepare composite working drawings and sections at a suitable scale not less than 1/4" = 1'0",

clearly showing how work is to be installed in relation to the work of other trades. If work under this division is installed before coordinating with other trades, or to cause any interference with work of other trades, make necessary changes to correct the condition without additional cost.

c. Furnish to other trades all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

2. Materials & Workmanship:
   a. Materials and apparatus required for the work shall be new and of first class quality. Furnished, delivered, erected, connected and finished in every detail. Select and arrange to fit properly into the building spaces. Where no specific kind or quality of material is given, furnish first class standard article as accepted by Engineer.
   b. Furnish the services of an experienced superintendent who shall be in constant charge of the work, together with skilled craftsmen and labor required to unload, transfer, erect, connect-up, adjust, start, operate, and test each system.
   c. All equipment and materials to be installed with the acceptance of the Engineer in accordance with the recommendations of the manufacturer. This includes the performance of such test as the manufacturer recommends.

3. Protection of Materials:
   a. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

   b. Welding: Before any welding is performed, submit a copy of the Welding Procedure Specification (WPS) together with the Procedure Qualification Record a required by Section IX of the ASME Boiler and Pressure Vessel Code.
      1) Before any welder performs any welding, submit a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section IX of the ASME Boiler and Pressure Vessel Code. The letter or symbol (as shown on the qualification test form) shall be used to identify the work of that welder and shall be affixed, in accordance with appropriate construction code, to each completed weld.
      2) The types and extent of non-destructive examinations required for pipe welds are shown in Table 136.4 of the Code for Pressure Piping, ASNI/ASME B31.1.

   c. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of

the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Engineer prior to the installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.5 CODES AND STANDARDS

A. Except as modified by governing codes, comply with applicable provisions and recommendations of the following:
   1. ANSI Standards.
   2. Owner's Insurance Company.
   3. Current Adopted Connecticut Codes, Laws and Statutes.

1.6 PERMITS, FEES, & INSPECTIONS

A. Give all necessary notices, obtain and pay for all permits, and pay all government sales taxes, fees, and other costs, including utility connections or extensions in connection with work. File necessary approvals of governmental departments having jurisdiction. Obtain required certificates of inspection for work and deliver a copy to the Owner or his authorized representative before requesting acceptance for final payment.

1.7 SCHEDULE & SEQUENCE

A. Temporary Services:
   1. Refer to the General Conditions and Special Conditions for a full description of the temporary services to be provided.

B. Temporary Openings:
   1. Ascertain from examination of the drawings any special temporary openings in the building required for the admission of apparatus provided under this Division. Notify the Owner accordingly. Contractor shall assume all costs of providing such openings thereafter.

C. Sequencing:
   1. Contractor shall coordinate sequence of work with owner's representative.

1.8 PROJECT & SITE CONDITIONS

A. Cutting, Patching, and Firestopping:
   1. Furnish all cutting, drilling and patching. Furnish sketches showing the locations and sizes of openings, chases, etc., required for the installation of

work. Furnish the Contractor with an approximation of the number and size of openings, chases, etc., required.

B. Waterproofing:
   1. Where any work pierces existing waterproofing, re-waterproof. The method of installation to be reviewed by Owner or his authorized representative before work is done. Furnish all sleeves, caulking, and flashing required to make openings watertight.

C. Fireproofing:
   1. Where any work penetrates a fire rated assembly, provide UL listed, firestopping with hourly rating equal to that of the penetrated assembly. Fireproofing shall be compatible with the pipe or equipment doing the penetration so that fire rating of the assembly is maintained.

1.9 DELIVERY, STORAGE, & HANDLING

A. Delivery & Receipt:
   1. Contractor is responsible for the delivery and storage of all materials, parts, equipment, etc. required for this project.

B. Storage:
   1. The Contractor shall store all material, parts, and equipment required for this project in accordance with supplier's and manufacturer's recommendations, and Owner's requirements.

C. Handling, Hoisting, Rigging, & Scaffolding:
   1. Furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished under this Division. Remove same from premises when no longer required.

1. 10 RECORD DOCUMENTS

A. Maintain at the job site a record set of drawings on which any changes in location of equipment, piping, valves, cleanouts, panels, ducts and major conduits shall be recorded. These shall be clearly marked on a clean set of prints at the completion of work for record drawings and turned over to the Owner.

B. Prepare record documents in accordance with the requirements below:
   1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, tanks, etc.). Valve location diagrams, complete with valve tag chart.
   2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
4. Contract Modifications, actual equipment and materials installed.

1.11 OPERATION & MAINTENANCE MANUALS FOR PLUMBING SYSTEMS

A. Bind Operation & Maintenance Manual for Plumbing System in a hard-backed binder.
   1. Provide a master index at beginning of Manual showing items included. Use plastic tab indexes for sections of Manual.
   2. First section shall consist of name, address, and phone number of Architect, Plumbing, Mechanical & Electrical Engineers, General Contractor and Mechanical, Plumbing, Sheet Metal, Refrigeration, Temperature Control & Electrical Contractors. Also include a complete list of equipment installed with name, address, and phone number of vendor.
   3. Provide section for each type of item of equipment.
   4. Submit three copies of Operation & Maintenance Manual to Engineer for his approval. Use one of these approved copies during final inspection and leave with building maintenance personnel.

B. Include descriptive literature (Manufacturer's catalog data) of each manufactured item. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.

1.12 WARRANTIES AND GUARANTIES

A. Guarantee all material and workmanship under this Division for a period of one year, from the date of final acceptance by the Owner.

B. During guarantee period, all defects developing through materials and/or workmanship shall be replaced immediately without expense to the owner. Make such repairs or replacements to the satisfaction of the Owner.

PART 2 - PRODUCTS

13. ACCEPTABLE MANUFACTURERS

A. As specified under other related sections.

B. As specified on drawings.

14. MATERIALS

A. As specified under other related sections.

B. As specified on drawings.

15. EQUIPMENT DEVIATIONS

A. Where the Contractor proposed to use an item of equipment or fixture other than that specified or detailed on the drawings which requires the redesign of the structure, partitions, foundations, piping, wiring or any other part of the original design layout, all such redesign, and all new drawings and detailing required therefore, shall be prepared at the Contractor's expense and are subject to the review and approval of the Engineer. Owner reserves the right to have the Engineer prepare any redesign work.

B. Where such accepted deviation requires a different quantity and arrangement of materials or equipment from that specified or indicated on the drawings, the Contractor will provide additional equipment and materials required at no additional cost to the Owner.

C. When equipment or methods deviate from original plans or specifications, the Contractor must submit a written request to deviate to the Engineer. At a minimum the request will address the following:

- equipment which is different than specified
- name and data related to the proposed deviation
- reason for deviation
- advantageous or disadvantageous to the Owner
- credit or increase in cost to the Owner
- guarantees or warranties offered (if any)
- acceptance of liability for equivalent performance.

1.16 FIRESTOPPING

A. Firestopping shall be UL listed, and tested in accordance with ASTM E814, E119, and E84.

B. Hourly rating shall be equal to or greater than that of the assembly being penetrated.

C. Firestopping shall be compatible with pipe or equipment penetrating the assembly. Fire rating of the assembly must be maintained.

D. Refer to firestopping specifications and details for additional requirements.

PART 3 - EXECUTION

1.17 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications for rough-in requirements.

1.18 PIPING SYSTEMS INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of plumbing systems, materials, and equipment. Comply with the following requirements:

4. Coordinate plumbing systems, equipment, and materials installation with other building components.
5. Verify all dimensions by field measurements.
6. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for plumbing installations.
7. Coordinate the installation of required supporting devices and sleeves to be set in structural components, as they are constructed.
8. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the Work.
9. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
10. Coordinate connection of plumbing systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
11. Install systems, materials, and equipment to conform with approved submittal data, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
12. Install piping behind finished surfaces unless other wise indicated. Piping within mechanical spaces/rooms shall be exposed.
13. Exposed piping shall be installed at right angle or parallel to building walls.
11. Install piping tight to walls, columns, beams, joists and other building elements.
12. Piping installed above accessible ceilings shall be installed with sufficient space to allow for the removal of respective ceiling panels.
13. Groups of piping shall be installed parallel to each other with sufficient spacing to allow for valve servicing and replacement.
14. Piping shall be installed at indicated slopes. Where slopes are not indicated, piping shall be installed as required by current adopted Code.
15. Install piping in such a manner as to eliminate any sags or bends.
16. Install respective fittings for all changes in direction and for branch connections.
17. Install piping to allow for installation of respective insulation plus one (1) additional inch of clearance all the wayt around the insulation.
18. System components shall have a pressure rating equal to or greater than maximum system pressure.

19. Provide escutcheons for all wall, ceiling and floor penetrations.
20. Provide sleeves for all piping passing through concrete/masonry walls, concrete floors and roof slabs as well as gypsum wallboard partitions.
21. Maintain fire rating of all walls, partitions, ceilings, flooring at pipe penetrations. Refer to Division 07.
22. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

1.19 PIPING JOINTS

A. General: Join piping components as indicated in other Divion 22 specification sections and drawings. Comply with the following requirements as well:
   1. Ream all ends of piping and remove burrs.
   2. Remove dirt, debris, scale and slag from the inside as well as the outside of all piping and fittings prior to assembly.
   3. Apply ASTM B 813 water flushable flux, unless otherwise indicated, to pipe ends and fittings of solder joints. Joints shall be constructed in accordance with ASTM B 828 using lead-free solder alloy complying with ASTM B 32.
   4. Brazed joints shall be constructed as per AW'S "Brazing Handbook – Pipe and Tube Chapter". Utilize copper-phosphorus brazing filler metal comply with AWS A5.8.
   5. Threaded joints shall be constructed utilizing threaded pipe with tapered pipe threads in accordance with ASME B1.20.1. Threads shall be cut full and clean utilizing sharp cutting dies. Ream threaded pipe ends to remove burrs and restore full I.D. Pipe fittings and valves shall be joined as follows:
      a. Apply appropriate thread tape or compound to exterior threads, unless dry seal thearing is specified.
      b. Pipe and pipe fitting with damage or corrded trheads shall not be utilized.
      c. Pipe sections with cracked or open welds shall not be utilized.

   6. Provide appropriate gasket material, size, type and thickness for flange joint for respective service application. Gasket shall be concentrically positioned. Utilize appropriate lubricant for bolt threads.
   7. Plastic piping solvent-cement joints shall comply with the following:
      a. Clean and dry joining surfaces.
      b. Comply with ASTM F 402 for safe handling practices of cleaners, primers and solvents.
      c. ABS piping shall be joined per ASTM D 2235 and ASTM D 2261 appendixes.
      d. CPVC piping shall be joined per ASTM D 2846 and ASTM D 2846M appendix.
      e. PVC pressure piping shall be joined per ASTM D 1785. PVC pipe and PVC socket fittings according to ASTM D 2672. Other than schedule number PVC pipe and socket fittings shall be joined in accordance with ASTM D 2855.
      f. PVC non-pressure piping shall be joined per ASTM D2855.

g. PVC to ABS non-pressure transition fittings shall be joined per ASTM D 3138 appendix.

8. Plastic pressure piping gasketed joints shall be joined per ASTM D 3139.
9. Plastic non-pressure piping gasketed joints shall be joined per ASTM D 3212.
10. PE Piping Heat-Fusion joints shall be cleaned, dried and joined in accordance with ASTM D 2657. Utilize butt fisuion for plain end pipe and fittings and socket fusion for plain end pipe and socket fittings.

1.20 PIPING CONNECTIONS

A. Comply with the following requirements unless otherwise noted.
   a. Piping NPS 2" or smaller: Provide unions adjacent to each valve and at final connection to each piece of equipment.
   b. Piping NPS 2-1/2" or larger: Provide flanges adjacent to flanged valves and at final connection to each piece of equipment.
   c. Dry piping systems: Provide dielectric unions and flanges for connection of piping utilizing dissimilar metals.
   d. Wet piping systems: Provide dielectric coupling and nipple fittings for connection of piping utilizing dissimilar metals.

1.21 EQUIPMENT INSTALLATION

A. Install equipment to provide maximum amount of headroom possible unless mounting heights are indicated.

B. Install equipment in accordance with manufacturers installation instructions and requirements.

C. Equipment shall be installed level and plumb as well as parallel and/or perdendicular to other building systems unless otherwise indicated.

D. Plumbing equipment shall be installed in such a manner as to facilitate the service, maintenance, repair and replacement of components.

E. Provide connections to equipment for ease of disconnection with minimum interference to other installations. Grease fittings shall be extended to an accessible area.

F. Installation of equipment shall give right of way to piping required to be installed at a slope.

1.22 FIELD QUALITY CONTROL

A. Perform field tests as specified under other sections.

B. Arrange for local inspection authorities to inspect work performed prior to burial, closing-in behind wall and above ceiling or encase in concrete. Also arrange for final inspection of work and obtain Final Inspection Certificate before final inspection by Owner or his representative.

1.23 TRAINING

A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the following systems and associated equipment including but not limited too:

- Hot water heaters, mixing valves and associated controls.
- Plumbing fixtures, flush valves, faucets and associated controls.
- Grease interceptor.
- Natural gas system, valves and associated controls.

B. All training shall be video recored. Refer to Division 01 Specification 01 79 00 Demonstration and Training for further requirements.

END OF SECTION 220500

SECTION 22 05 19 – METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of meters and gages:

1. Temperature gages and fittings.
2. Pressure gages and fittings.
3. Flow meters.

B. Meters and gages furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 22 and 23 sections.

1.2 SUBMITTALS

A. General: Submit the following:
1. Product data for each type of meter and gage. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
2. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and products' compliance with specified requirements.

1.3 QUALITY ASSURANCE

A. UL Compliance: Comply with applicable UL standards pertaining to meters and gages.

B. ASME and ISA Compliance: Comply with applicable portions of ASME and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

PART 2 - PRODUCTS

2.1 THERMOMETERS, GENERAL

A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

B. Scale range: Temperature ranges for services listed as follows:

1. Domestic Hot Water: 30 to 240 deg with 2-degree scale divisions (0 to 115 deg C with 1-degree scale divisions).

2. Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions (minus 18 to 38 deg C with 1-degree scale divisions).

2.2 PRESSURE GAGES

B. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon- tube type, bottom connection.

C. Case: Drawn steel or brass, glass lens, 4-1/2-inches diameter.

D. Connector: Brass, 1/4-inch NPS.

E. Scale: White coated aluminum, with permanently etched markings.

F. Accuracy: Plus or minus 1 percent of range span.

G. Range: Conform to the following:

1. Vacuum: 30 inches Hg to 15 psi.
2. All fluids: 2 times operating pressure.

2.3 PRESSURE GAGE ACCESSORIES

A. Syphon: 1/4-inch NPS straight coil constructed of brass tubing with threads on each end.

B. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

2.4 FLOW METERS, GENERAL

A. Flow rate of elements and meters shall be same as connected equipment or system.

2.5 METERS

A. Permanently Mounted Meters: Suitable for mounting on wall or bracket, 6-inch dial or equivalent with fittings and copper tubing for connecting to flow element.

B. Scale shall be in gpm unless otherwise indicated.

C. Accuracy: Plus or minus 1 percent between 20 to 80 percent of range.

D. Portable Meters: Differential-pressure gage and two 12-foot hoses in carrying case with handle.

E. Scale: In inches of water unless otherwise indicated.

F. Accuracy: Plus or minus 2 percent between 20 to 80 percent of range.

G. Each meter shall be complete with operating instructions.

2.6 WINDOW-TYPE FLOW METERS

A. Type: Window-type flow meters designed for installation on hydronic piping and measure flow directly in gpm.

B. Construction: Bronze body and impact tube, integral self-closing valve, glass calibrated tube with indicator ball, and protection shield. Meters shall be pressure rated for 150 psig and temperature rated for 240 deg F (116 deg C).

C. Accuracy: Plus or minus 5 percent.

2.7 BTU METERS

A. Type: BTU meters consisting of turbine wheel flow meter, 2 temperature sensors, solid-state calculator with integral battery pack, integral stop valves, strainer, and magnetic trap.

B. Construction: Bronze housing, 125 psig rating.

C. Temperature Ranges: 40 to 250 deg F (5 to 120 deg C).

D. Data Output: 6-digit electromechanical counter with readout in KWH or BTU.

E. Accuracy: Plus or minus 1 percent.

F. Battery Pack: 5-year lithium battery.

2.8 TEST PLUGS

A. Test Plugs shall be nickel-plated brass body, with 1/2-inch NPS fitting and 2 self-sealing valve-type core inserts, suitable for inserting a 1/8-inch O.D. probe assembly from a dial-type thermometer or pressure gage. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation. Pressure rating shall be 500 psig.

B. Core Material: Conform to the following for fluid and temperature range:

1. Air, Water, Oil, and Gas, 20 to 200 deg F (minus 7 to 93 deg C): Neoprene.
2. Air and Water, minus 30 deg to 275 deg F (minus 35 to 136 deg C): EPDM.

C. Test Kit: Provide test kit consisting of 1 pressure gage, gage adapter with probe, 2 bimetal dial thermometers, and carrying case.

D. Ranges of pressure gage and thermometers shall be approximately 2 times systems operating conditions.

PART 3 - EXECUTION

3.1 THERMOMETERS INSTALLATION

A. Install thermometers in vertical and tilted positions to allow reading by observer standing on floor.

B. Install in the following locations and elsewhere as indicated:

1. At inlet and outlet of each indirect water heater.

C. Remote-Reading Dial Thermometers: Install in control panels, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

D. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

3.2 INSTALLATION OF PRESSURE GAGES

A. Install pressure gages in piping tee with pressure gage valve, located on pipe at most readable position.

B. Install in the following locations, and elsewhere as indicated:

1. At suction and discharge of each pump.
2. At discharge of each pressure-reducing valve.
3. At building water service entrance.

C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon in lieu of snubber for steam pressure gages.

3.3 INSTALLATION OF TEST PLUGS

A. Test Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.4 INSTALLATION OF FLOW-MEASURING ELEMENTS AND METERS

A. General: Install flow meters for piping systems located in accessible locations at most readable position.

B. Locations: Install flow measuring elements and meters in the following locations and elsewhere as indicated.

1. At discharge of each pump.
2. At inlet of each hydronic coil in built-up central systems.

C. Differential-Pressure-Type Flow Elements: Install minimum straight lengths of pipe upstream and downstream from element as prescribed by the manufacturer's installation instructions.

D. Install wafer orifice-type element between 2 Class 125 pipe flanges, ANSI B16.1 (cast iron) or ANSI B16.24 (bronze).

E. Install connections for attachment to portable flow meters in a readily accessible location.

F. Meters For Use With Flow Elements: Install meters on wall or bracket in accessible location.

G. Install connections, tubing, and accessories between flow elements and meters as prescribed by the manufacturer's installation instructions.

H. Window Flow Meters: Install in vertical upward position with impact tube mounted in bushing centered on pipe with 10 pipe diameters upstream and 5 pipe diameters downstream of straight unrestricted piping for 1-1/4 inches and smaller, 20 pipe diameters upstream and 10 pipe diameters downstream for 1-1/2 inches and larger. Calibrate meter after installation in accordance with manufacturer's installation instructions.

3.5 ADJUSTING AND CLEANING

A. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint.

END OF SECTION 22 05 19

SECTION 22 05 23 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

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 this section.

1.2 SUMMARY

A. This Section includes general duty valves common to most mechanical piping systems.

1. Special purpose valves are specified in individual piping system specifications.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers:

1. Engineer approved equal

2.2 VALVE FEATURES, GENERAL

A. Valve Design: Rising stem or rising outside screw and yoke stems as indicated.

1. Nonrising stem valves may be used where indicated.

B. Pressure and Temperature Ratings: As required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Provide the following special operator features:

1. Handwheels, fastened to valve stem, for valves other than quarter turn.
2. Lever handles, on quarter-turn valves 6-inch and smaller, except for plug valves.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

G. End Connections: As indicated in the valve specifications.

1. Threads: Comply with ANSI B1.20.1.
2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
3. Solder-Joint: Comply with ANSI B16.18.
   a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 GATE VALVES

A. Gate Valves, 2-Inch and Smaller: MSS SP-80; Class 125, body and bonnet of ASTM B 62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.

B. Gate Valves, 2-1/2-Inch and Larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with flanged ends, "Teflon" impregnated packing, and two-piece backing gland assembly.

2.4 BALL VALVES

A. Ball Valves, 1 Inch and Smaller: Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; two-piece construction; with bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, and vinyl-covered steel handle. Provide solder ends for domestic hot and cold water service; threaded ends for heating hot water.

B. Ball Valves, 1-1/4-Inch to 2-Inch: Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 3-piece construction; with bronze body conforming to ASTM B 62, conventional port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for domestic hot and cold water service; threaded ends for heating hot water.

2.5 PLUG VALVES

A. Plug Valves, 2-Inch and Smaller: Rated at 150 psi WOG; bronze body, with straightaway pattern, square head, and threaded ends.

B. Plug Valves, 2-1/2-Inch and Larger: MSS SP-78; rated at 175 psi WOG; lubricated plug type, with semisteel body, single gland, wrench operated, and flanged ends.

2.6 GLOBE VALVES

A. Globe Valves, 2-Inch and Smaller: MSS SP-80; Class 125; body and screwed bonnet of ASTM B 62 cast bronze; with threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.

B. Globe Valves, 2-1/2-Inch and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing, and two-piece backing gland assembly.

2.7 BUTTERFLY VALVES

A. Butterfly Valves, 2-1/2-Inch and Larger: MSS SP-67; rated at 200 psi; cast-iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, nickel-plated ductile iron disc (except aluminum bronze disc for valves installed in condenser water piping), stainless steel stem, and EPDM O-ring stem seals. Provide lever operators with locks.

2.8 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

B. Swing Check Valves, 2-1/2-Inch and Larger: MSS SP-71; Class 125 cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.

B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

C. Examine threads on both the valve and the mating pipe for form (i.e., out-of-round or local indentation) and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

F. Replace defective valves with new valves.

3.2 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2-Inch and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
2. Steel Pipe Sizes, 2-Inch and Smaller: threaded ends.
3. Steel Pipe Sizes 2-1/2 Inch and Larger: flanged ends.

3.3 VALVE INSTALLATIONS

A. General Application: Use gate, ball, and butterfly valves as indicated.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install valves in horizontal piping with stem at the center of the pipe.

E. Install valves in a position to allow full stem movement.

F. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.

3.4 SOLDER CONNECTIONS

A. Cut tube square and to exact lengths.

B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

D. Open gate and globe valves to full open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.5 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.6 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.7 FIELD QUALITY CONTROL

A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.8 ADJUSTING AND CLEANING

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.9 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

VALVES, 2-INCH AND SMALLER

SERVICE	GATE	GLOBE	BALL	CHECK
Domestic Hot and Cold Water	125	125	150	125

VALVES, 2-1/2-INCH AND LARGER

SERVICE	GATE	GLOBE	BUTTERFLY	CHECK
Domestic Hot and Cold Water	125	125	200	125

END OF SECTION 22 05 23

SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The work of this section includes but is not limited to the following:

1. Vibration isolation elements.
2. Equipment isolation bases.
3. Piping flexible connections.
4. Seismic restraints for isolated and non-isolated mechanical and electrical items.

1.2 REFERENCES

A. State of Connecticut Building Code.

B. NFPA 13 - Installation of Sprinkler Systems.

C. ASHRAE-A Practical Guide to Seismic Restraint.

D. Mason Industries, Inc. Seismic Restraint Guidelines

1.3 QUALIFICATIONS

A. Qualifications: Only firms having five years experience designing and manufacturing seismic devices shall be capable of work in this specification.

1.4 SUBMITTALS

A. The submittal material shall include copies of descriptive data for all products and materials including but not limited to the following:

1. Descriptive Data:

a. Catalog cuts and data sheets.
b. An itemized list showing the items to be isolated and/or seismically restrained, product type or model number to be used and loading and deflection data.
c. Seismic restraint calculations.
d. (Structural or civil engineer’s State of Connecticut professional engineer’s seal verifying design and calculations for seismic restraining system used.)

2. Shop Drawings:

a. Drawings showing equipment base construction for each machine, including dimensions, structural member sizes, and support point locations.
b. Drawings showing methods of suspension, support guides for conduit, piping and

ductwork.

c. Drawings showing methods for isolation of conduits, pipes and ductwork penetrating walls and floor slabs.
d. Concrete and steel details for bases including anchor bolt locations.
e. Number location of seismic restraints and anchors for each piece of equipment.
f. Specific details of restraints including anchor bolts for mounting and maximum loading at each location, for each piece of equipment and/or pipe and duct locations.

1.5 GENERAL (MANUFACTURER) RESPONSIBILITIES

A. Design Builder shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations per specifications.
2. Provide and install isolation systems and seismic restraints as scheduled or specified.
3. Guarantee specified isolation system deflection.
4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
5. Substitution of “Internally Isolated” mechanical equipment in lieu of the specified isolation of this section may be acceptable provided that all specified deflections and stamped seismic calculations are supplied by the equipment manufacturer.

1.6 PROJECT RECORD DOCUMENTS

A. Record actual locations and installation of vibration isolators and seismic restraints including attachment points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Mason Industries Inc. models listed below.

2.2 SEISMIC RESTRAINT TYPES

A. General: Installations shall be designed to safely accept external forces of one-half “G” load in any direction for all rigidly supported equipment without failure and permanent displacement of the equipment. Life safety equipment such as (fire pumps, sprinkler piping and emergency generators) shall be capable of safely accepting external forces up to one “G” load in any direction without permanent displacement of the supported equipment. Seismic restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise.

B. Type II (snubber): Each corner of side shall incorporate a seismic restraint having a minimum 5/8” thick resilient pad limit stops working in all directions. Restraints shall be made of plate, structural members, or square metal tubing concentric within a welded assembly incorporated resilient pads. Angle bumpers are not acceptable. System to be field bolted or welded to a

deck with 1 G acceleration capability. Mason Type Z-1011 and Z-1225.

C. Type III (cable braces): Metal cable type with approved end fastening devices to equipment and structure. System to be field bolted to deck or overhead structural members using two sided beam clamps to steel or appropriately designed insert for concrete. All parts of system including cables, clamps, excluding fastenings are to be single vendor furnished to assure seismic compliance. Mason Type SCB.

D. Type V: Non-isolated equipment to be field bolted or welded (powder shots not acceptable) to resist seismic forces unless under 100 lb. Shear force required. Mason Type SAS, SAB.

2.3 VIBRATION ISOLATION - GENERAL

A. Vibration Isolation shall control excessive noise and vibration in the building due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork, or conduit. (The installation of all vibration isolation units, and associated hangers and bases, shall be under the direct supervision of the vibration isolation manufacturer's representative.)

B. All vibration isolators shall have either known non-deflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection can be verified.

C. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.

D. The theoretical vertical natural frequency for each support point, bases upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than +/- 10%.

E. All neoprene mountings shall have a Shore hardness of 30 to 60 +/- 5, after minimum aging of 20 days or corresponding oven aging.

2.4 VIBRATION ISOLATOR TYPES:

A. Type E: Elastomer hanger rod isolators:

1. Molded unit type neoprene element with projecting bushing lining rod clearance hole.
2. Neoprene element to be minimum 1-3/4" thick.
3. Steel retainer box encasing neoprene mounting.
4. Clearance between mounting hanger rod and neoprene bushing shall be minimum of 1/8".
5. Minimum static deflection of 0.35".
6. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
7. Mason Type HD.

B. Type F: Combination spring/elastomer hanger rod isolators:

1. Spring and neoprene isolator elements in a steel box retainer. Neoprene double deflection type. Single deflection is unacceptable. Spring seated in a neoprene cup with extended rod bushing.
2. Characteristics of spring and neoprene as described in Type A and Type E isolators.
3. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
4. Mason Type DNHS.

C. Type G: Pad type elastomer mountings:

1. ¾" Minimum thickness.
2. 50 PSI maximum loading.
3. Waffled design.
4. Deflection per pad thickness.
5. Galvanized steel plate between multiple layers or pad thickness.
6. Suitable bearing plate to distribute load.
7. Mason Type Super W.

D. Type H: Grommet type elastomer bushings:

1. One piece molded bridge bearing neoprene.
2. Washer / bushing shall surround the anchor bolt.
3. Flat washer face to avoid metal to metal contact.
4. Mason type HG.

E. Type K: Pipe Anchors: All-directional acoustical pipe anchor consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum one-half inch thickness of heavy-duty neoprene and duck or neoprene isolation material. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction.

Allowable loads on the isolation material travel in either direction. Allowable loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction. Isolation to be bolted or welded depending on structure. Mason Type ADA.

2.5 EQUIPMENT BASES

A. Concrete Inertia Base, Type B-2:

1. Vibration isolator manufacturer shall furnish rectangular structural concrete forms for floating foundation. The base depth shall be a minimum of 1/10 of the longest dimension of the base but not less than 6" or greater than 14". Forms shall include minimum concrete reinforcement consisting of ½"bars or angles welded in place in 6" centers running both ways in a layer 1-1/2" above the bottom and a top layer of reinforcing
2. steel as above for all bases exceeding 120" in one direction. Isolators shall be set into pocket housings which are an integral part of the base construction and set at the proper height to maintain a 1" clearance below the base. Bases shall be furnished with templates and anchor bolt sleeves as part of this system.

3. Must be utilized with seismic restraint Type I, II or IV.
4. Mason Type K, BMK.

2.6 FLEXIBLE CONNECTORS

A. Elastomer Type FC-1:

1. Manufactured of Kevlar reinforcement and EPDM, both molded and cured with hydraulic presses.
2. Straight connectors to have two spheres reinforced with a molded-in external ductile iron ring between spheres.
3. Elbows shall be long radius type.
4. Rated 250 psi at 170 degrees F. Dropping in a straight line to 170 psi at 250 degrees F for sizes 1-1/2" to 12" elbows. Elbows shall be rated no less than 90% of straight connections.
5. Sizes 10" to 12" to employ control cables with neoprene end fittings isolation from anchor plates by means of ½"
6. bridge bearing neoprene bushings.
7. Minimum safety factor, 4:1 at maximum pressure ratings.
8. Systems bolted to victaulic type couplings or gate, butterfly, or check valves to have a minimum 5/8" flange spacer installed between conductor and coupling on flange.
9. Submittals to include test reports.
10. Mason Type Safeflex SFDEJ.

B. Flexible Stainless Hose, Type FC-2:

1. Type 321 stainless steel braided flexible metal hose.
2. 2" pipe size and smaller: threaded carbon steel fittings.
3. 1-1/2" pipe size and larger: Class 150 carbon steel flanges.
4. Suitable for operating pressure with 4:1 minimum safety factor.
5. Flexible Metal Hose Company type DFC and MFC.

C. Unbraided Exhaust Hose, Type FC-3:
1. Low pressure stainless steel annularly corrugated.
2. Fitted with flanged ends.
3. Maximum temperature 1,500 degrees F.
4. Mason Type SDL-RF.

PART 3 - EXECUTION

3.1 GENERAL SEISMIC RESTRAINT REQUIREMENTS

A. Install seismic restraints in accordance with manufacturers recommendations.

B. Seismic restraining system Type III: Install taut for non-isolated equipment and slack with ½" cable deflection for isolated systems.

C. Seismically restrain all piping, conduit and ductwork with Type III or Type V seismic restraint in accordance with guidelines outlined below. Restraints which are to be used in conjunction with vibration isolators shall be Type III.

1. Carbon steel piping shall be braced at maximum 40’ intervals and at turns of more than 4’. Lateral bracing at maximum 80’ intervals. No-hub piping to be braced at maximum 20□ intervals or maximum 40” using 1/2 G acceleration rated couplings.
2. Ductwork shall be braced at maximum 30’ and at every turn and duct run end. Lateral bracing at maximum 60’.

D. Equipment mounted on housekeeping pads: Pads shall be properly doweled or expansion shielded to deck to meet acceleration criteria. Mason Type HPA.

E. Seismic Restraints are not required for the following:

1. Piping in boiler or mechanical rooms or penthouses less than 1-1/4” O.D. except gas piping and fire protection piping.
2. Piping in other areas less than 2-1/2” O.D., except gas piping and fire protection piping.
3. Ducts which have a cross sectional area less than 6 square feet.
4. All piping suspended by individual hanger 12” or less in length from the top of the pipe to the bottom of the support for the hanger, except gas piping and fire protection piping.
5. Fire protection feed mains and cross mains suspended by individual hangers 6” or less in length from the top of the pipe to the bottom of the support for the hanger.
6. All top supported ducts suspended by hangers 12” or less in length from the top of the duct to the bottom of the support for the hanger.
7. Electrical conduit less than 1-1/2” I.D.

F. For overhead supported equipment, over stress of the building structure must not occur. Bracing can occur from:

1. Flanges to structural beams.
2. Upper or lower truss chords in bar joist construction at panel points.
3. Cast-in-place inserts or drilled and shielded inserts in concrete structures.

G. Building seismic expansion joints: Install hinged joints at piping crossing expansion joints and anchor the piping either side per the detail provided on the contract drawings. Anchors on each end are to be capable of accepting 1.5 times the operating pressure multiplied by the projected area of the pipe. Offset shall be accomplished by the annular motion of a double sphere connector (TYPE FC-1) bolted to each end of an intermediate steel pipe. Bracket each joint with hinged steel connections. Hinges shall have a pin / slot assembly on both sides. The completed assembly shall be Mason Type Safeflex SFDEJ-HE.

3.2 GENERAL VIBRATION ISOLATION REQUIREMENTS

A. Install isolators in accordance with manufacturer’s recommendations. Vibration isolators shall not cause any change of position resulting in stresses or misalignment.

B. Mechanical equipment shall be isolated from the building structure by means of noise and vibration isolators.

C. Each fan and motor assembly shall be supported on a single structural steel frame (where noted on the isolation and seismic schedule). Flexible duct connections shall be provided at inlet and discharge ducts.

D. Provide pairs of horizontal limit springs (Thrust restraints) on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans where indicated

E. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch (1.5 mm) maximum clearance. Other snubbers shall have clearance between 0.15 inch (4 mm) and 0.25 inch (7 mm).

F. Installation of piping vibration isolators:

1. All piping, except fire protection standpipe systems, is included under this section.
2. Vibration isolators shall be installed on all piping outside the shafts as follows:

    a. Piping in boiler or mechanical rooms.
    b. Piping where exposed on roof.
    c. Piping connected to rotating equipment and pressure reducing stations.

3. Horizontal suspended pipe 2” and smaller and all steam piping shall be suspended by Type E isolator with a minimum 3/8” deflection. Water pipe larger than 2” shall be supported by Type C or Type F isolator with minimum 1” whichever is greater.
4. Horizontal pipe floor supported at slab shall be supported via Type A with a minimum static deflection of 1” or same deflection as isolated equipment to which pipe connects, whichever is greater.
5. Vertical riser pipe supports under 2” diameter shall utilize Type G isolation pads.
6. Vertical riser guides, if required, shall avoid direct contact of piping with building.
7. Pipe anchors or guides, where required, shall utilize resilient pipe anchors, Mason Industries Type ADA, or equivalent, to avoid direct contact of piping with building.
8. Isolated piping which requires sway bracing shall utilize two neoprene elements, Type G to accommodate tension and compression forces.
9. Pipe extension and alignment connectors: Provide connectors at riser takeoffs, cooling and heating coils, and elsewhere as required, to accommodate thermal expansion and misalignment.

G. Pipe Isolation Schedule

PIPE SIZE - INCH (MM)	ISOLATED DISTANCE FROM EQUIPMENT
1 (25)	120 diameters (3.0m)
2 (50)	90 diameters (4.5m)
3 (80)	80 diameters (6.0m)
4 (100)	75 diameters (7.5m)

6 (150)	60 diameters (9.0m)
8 (200)	60 diameters (12.0m)
10 (250)	54 diameters (13.5m)
12 (300)	50 diameters (15.0m)
16 (400)	45 diameters (18.0m)
24 (600)	38 diameters (23.0m)

3.3 EQUIPMENT INSTALLATION

A. Requirements for installation on concrete inertia bases shall be as follows:

1. Minimum operating clearance between concrete inertia and base and housekeeping pad or floor shall be 1".
2. The equipment structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine or isolators.
3. The isolators shall be installed without raising the machine and frame assembly.
4. After the entire installation is complete and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.
5. Install equipment with flexibility in wiring connection.
6. Verify that all installed isolator and mounting systems permit equipment motion in all directions. Adjust or provide additional resilient restraints to flexibly limit start-up equipment lateral motion to ¼".
7. Prior to start-up, clean out all foreign matter between bases and equipment. Verify that there are no isolation short circuits in the base, isolators, or seismic restraints.

3.4 INSPECTION

A. Upon completion of the installation of all vibration isolation and seismic restraints, the manufacturer's local representative shall visit the project jobsite, visibly inspect all installations and report, in writing, any and all deficiencies from the specifications. Any additional corrective measures required to put the system in total compliance shall be the responsibility of the installing Design Builder.

Vibration Isolation and Seismic Restraint Schedule

EQUIPMENT	BASE	ISOLATOR	SEISMIC RESTRAINT	DEFLECTION
ALL DOMESTIC WATER HEATERS			II	

END OF SECTION 22 05 48

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Identification devices specified in this section include the following:

1. Painted Identification Materials.
2. Plastic Pipe Markers.
3. Plastic Tape.
4. Underground-Type Plastic Line Marker.
5. Plastic Duct Markers.
6. Valve Tags.
7. Valve Schedule Frames.
8. Engraved Plastic-Laminate Signs.
9. Plastic Equipment Markers.
10. Plasticized Tags.

B. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division-23 sections.

C. Refer to Division-26 sections for identification requirements of electrical work; not work of this section.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special

"flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical identification materials:

1. Engineer approved equal.

2.2 MECHANICAL IDENTIFICATION MATERIALS:

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-15 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS:

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/4" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.4 PLASTIC PIPE MARKERS:

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1

B. Pressure-Sensitive Type: Provide manufacturer's standard pre- printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1

C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the 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" wide; full circle at both ends of pipe marker, tape lapped 3".
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

F. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Owner/Owner’s Representative in cases of variance with names as shown or specified.

G. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

2.5 PLASTIC TAPE:

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 UNDERGROUND-TYPE PLASTIC LINE MARKER:

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.

1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.7 VALVE TAGS:

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.

1. Provide 1-1/2" diameter tags, except as otherwise indicated.
2. Provide size and shape as specified or scheduled for each piping system.
3. Fill tag engraving with black enamel.

B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.

1. Provide 1-1/2" sq. black tags with white lettering, except as otherwise indicated.
2. Provide size, shape and color combination as specified or scheduled for each piping system.

C. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.

1. Provide 1-1/8" sq. white tags with black lettering.
2. Provide size, shape and color combination as specified or scheduled for each piping system.

D. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

E. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.8 VALVE SCHEDULE FRAMES:

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.9 ENGRAVED PLASTIC-LAMINATE SIGNS:

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16", except as otherwise indicated.

C. Thickness: 1/8", except as otherwise indicated.

D. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

E. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.10 PLASTIC EQUIPMENT MARKERS:

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:

1. Yellow: Heating equipment and components.
2. Blue: Equipment and components that do not meet any of the above criteria.
3. For hazardous equipment, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and plan number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide approximate 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.11 PLASTICIZED TAGS:

A. General: Manufacturer's standard pre-printed or partially pre- printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre- printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.12 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
   1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS:

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION:

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

   1. Stenciled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2" beyond ends of lettering.
   2. Stenciled markers, with lettering color complying with ANSI A13.1.
   3. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
   4. Stenciled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

   1. Near each valve and control device.
   2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
   3. Near locations where pipes pass through walls or floors/ ceilings, or enter non-accessible enclosures.
   4. At access doors, manholes and similar access points which permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
   7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.3 UNDERGROUND PIPING IDENTIFICATION:

A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.4 VALVE IDENTIFICATION:

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

1. Tagging Schedule: Comply with requirements of "Valve Tagging Schedule" at end of this section.

B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION:

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gages, thermometers and similar units.
3. Fuel-burning units including boilers, furnaces, heaters, stills and absorption units.
4. Pumps, compressors, chillers, condensers and similar motor- driven units.
5. Fans, blowers, primary balancing dampers and mixing boxes.
6. Tanks and pressure vessels.
7. Strainers, filters, humidifiers, water treatment systems and similar equipment.

B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).

1. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

3.6 ADJUSTING AND CLEANING:

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.7 EXTRA STOCK:

A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION 22 05 53

SECTION 22 07 19 – PLUMBING PIPE INSULATION

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.

B. Division-23 ‘Common Work Results for HVAC’ sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of mechanical insulation required by this section is indicated by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Plumbing Systems Insulation:
   a. Fiberglass.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

B. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Engineered approved equal.

2.2 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. K-factor maximum of 0.25 at 75 degrees F.

B. Jackets for Piping Insulation: ASTM C 921, Type I (vapor barrier) for piping with temperatures below ambient, Type II for piping with temperatures above ambient.

1. Encase pipe fittings insulation with one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.

C. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

D. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PLUMBING PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, drainage piping buried piping, fire protection piping, and pre- insulated equipment.

B. Domestic Cold Piping:

1. Application Requirements: Insulate the following cold plumbing piping systems:
   a. Domestic cold water piping.
   b. Plumbing vents within 6 lineal feet of roof outlet.
   c. Waste Piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
   a. Fiberglass: thickness per most current IECC with vapor barrier.

C. Domestic Hot Supply and Return Piping:

1. Application Requirements: Insulate the following hot plumbing piping systems:
   a. Domestic hot water supply and return recirculating piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
   a. Fiberglass: Provide thickness as required per the following:
      3/8" diameter to 1/2" diameter = R-5
      5/8" diameter to 3/4" diameter = R-7
      7/8" diameter to 2" diameter = R-9
      2-1/2" diameter to 4" diameter = R-8

3.3 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose. All proposed piping shall be insulated.

B. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

C. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

E. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

F. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

G. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

3.5 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 22 07 19

SECTION 22 11 13 - WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of the following Division 23 Sections apply to this section:

1. "Common Work Results for HVAC."
2. "Hangers and Supports for HVAC Pipe and Equipment."

1.2 SUMMARY

A. This Section includes domestic cold water, hot water, fittings, and specialties within the building.

1.3 DEFINITIONS

A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.

B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distributing system of the building served.

C. Pipe sizes used in this Specification are nominal pipe size (NPS).

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract.

1. Product data for each piping specialty meter and valve specified.
2. Test reports specified in Part 3 of this Section.
3. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following codes:

1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store pipe in a manner to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate the installation of pipe sleeves for foundation wall penetrations.

1.8 EXTRA MATERIALS

A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, fixture supply, or faucet installed.

PART 2 - PRODUCTS

2.1 PIPE AND TUBE MATERIALS, GENERAL

A. Pipe and Tube: Refer to Part 3, Article "Application, General," for identification of systems where the below materials are used.

B. Copper Tube: ASTM B 88, Type L Water Tube, drawn temper.

C. Copper Tube: ASTM B88, Type K water tube, annealed temper.

2.2 FITTINGS

A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.

B. Wrought Copper and Bronze Grooved-End Fittings: ASTM B 75 Tube and ASTM B 584 Bronze Castings.

C. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.

D. Unions: ASME B16.39, malleable iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces, female threaded ends. Threads shall conform to ASME B1.20.1.

E. Dielectric Unions: Threaded, solder, or grooved-end connections as required to suit application; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

2.3 JOINING MATERIALS

A. Solder Filler Metal: ASTM B 32, 95-5 Tin-Antimony.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.

2.4 GENERAL-DUTY VALVES

A. General-duty valves (i.e., gate, globe, check, and ball, valves) are specified in Division 23 Section "Valves." Special duty valves are specified below by their generic name; refer to Part 3 Article "Valve Application" for specific uses and applications for each valve specified.

2.5 SPECIAL DUTY VALVES

A. Balance Cocks: 400 psi WOG, 2 piece bronze, ball valve, handle, memory stop, with solder-end connections.

2.6 PIPING SPECIALTIES

A. Y-type Strainers: Cast-iron body, epoxy coated 125 psi flanges, removable cover with blow down tapping removable noncorrosive perforated strainer having 1/8 inch perforations.

B. Water mixing valves shall be of the thermostatic type with liquid filled thermal motor. It shall have bronze body construction with replaceable corrosion resistant components. Valve construction shall employ a sliding piston control mechanism. Sliding piston and liners shall be of stainless steel material. Valve shall come equipped with union end stop and check inlets with removable stainless steel strainers. Valve shall provide protection against hot or cold supply line failure and the thermostat failure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine rough-in requirements for plumbing fixtures and other equipment with water connections to verify actual locations of piping connections prior to installation.

3.2 PIPE APPLICATIONS

A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 4 inches and smaller, above ground, within building. Install Type K, annealed temper copper tube for pipe sizes 4 inches and smaller, with minimum number of brazed joints, below ground.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and branch connections.

C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

I. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls with sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inches shall be galvanized steel pipe; pipe sleeves 6 inches and larger shall be galvanized steel sheet metal.

J. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 7 for special sealers and materials.

K. Install piping level with no pitch.

L. Expansion loops shall be provided in hot water piping. Expansion joints are to be avoided.

3.4 HANGERS AND SUPPORTS

A. General: Hanger, support, and anchor devices conforming to MSS SP-69 are specified in Division 23 Section "Hangers and Supports for HVAC Pipe and Equipment." Conform to the table below for maximum spacing of supports:

B. Pipe Attachments: Install the following:

1. Adjustable steel clevis hangers, MSS Type 1, for individual horizontal runs.
2. Riser Clamp to support vertical runs.

C. Install hangers for individual horizontal piping with the following maximum spacing and minimum rod sizes:

Nom. Pipe Size - In.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 3/4	6	3/8

1 6	3/8	
1-1/4	6	3/8
1-1/2	10	3/8
2 10	3/8	
2-1/2	10	1/2
3 10	1/2	
3-1/2	10	1/2
4 10	1/2	

D. Support vertical copper tube at each floor.

3.5 PIPE AND TUBE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
2. Fill the tubing and fittings during soldering and brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
3. Heat joints to proper and uniform temperature.

C. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.6 VALVE APPLICATIONS

A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shut-off duty: Use gate, ball, and butterfly valves.
2. Throttling duty: Use globe, ball, and butterfly valves.

3.7 INSTALLATION OF VALVES

A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections and elsewhere as indicated.

B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, all branch lines and risers and elsewhere as indicated. For shutoff valves 2 inches and smaller, use gate or ball valves; for shutoff valves 2-1/2 inches and larger, use gate valves.

C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low

points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use gate or ball valves.

D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.

E. Balance Cocks: Install in each hot water recirculating loop, discharge side of each pump, and elsewhere as indicated.

3.8 INSTALLATION OF PIPING SPECIALTIES

A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.

B. Install water hammer arrestors for each flush valve. Size in accordance with manufacturer's instructions.

3.9 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.

B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection.

3.10 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution piping as follows:

1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
    a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
    b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
3. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
4. Reports: Prepare inspection reports signed by the plumbing official.

B. Test water distribution piping as follows:

1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Prepare reports for all tests and required corrective action.

3.11 ADJUSTING AND CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in the 2003 International Plumbing Code.
   a. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities.

3.12 COMMISSIONING

A. Fill the system. Check that the system is completely full of water.

B. Before operating the system, perform these steps:
1. Close drain valve, hydrants, and hose bibs.
2. Open valves to full open position.
3. Remove and clean strainers.
4. Check pumps for proper direction of rotation. Correct improper wiring.
5. Lubricate pump motors and bearings.

END OF SECTION 22 11 13

SECTION 22 13 16 – SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes building sanitary and storm drainage and vent piping systems, including drains and drainage specialties.

1.2 DEFINITIONS

A. Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.

B. Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.

C. Drainage System: Includes all the piping within a public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.3 SUBMITTALS

A. Product data for the following products:

1. Drainage piping specialties

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: comply with the provisions of the following:

1. International Plumbing Code.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof drains, flashing, and roof penetrations.

B. Coordinate flashing materials installation of roofing, waterproofing, and adjoining substrate work.

C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.

D. Coordinate with installation of sanitary and storm sewer systems as necessary to interface building drains with drainage piping systems.

PART 2 - PRODUCTS

2.1 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

A. Copper Tube: ASTM B306, Type DWV for pipe, and cast-bronze, drainage pattern fittings, with soldered joints.

1. Solder Filler Materials: ASTM B32, 50-50 tin-lead solder.

B. Cast-Iron Soil Pipe: ASTM A74, Service weight, hub-and-spigot soil pipe and fittings.

1. Clamps and compression gaskets: ASTM C564.

C. Hubless Cast-Iron Soil Pipe: CISPI Standard 301, Service weight, cast-iron soil pipe and fittings, with neoprene gaskets conforming to CISPI Standard 310.

2.2 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

A. Cast-Iron Soil Pipe: ASTM A74, Extra-Heavy weight, hub-and-spigot soil pipe and fittings. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces.

1. Neoprene Compression Gaskets: ASTM C564.

2.3 DRAINAGE PIPING SPECIALTIES

A. Backwater Valves: Valve assembly shall be bronze fitted cast-iron, with bolted cover. Flapper shall provide a maximum 1/4 inch clearance between flapper and seat for air circulation. Valve ends shall suit piping material.

B. Trap Primers: Bronze body valve with automatic vacuum breaker, with 1/2 inch connections matching piping system. Complying with ASSE 1018.

C. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.

D. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.

E. Floor Cleanouts: Cast-iron body and frame, with cleanout plug and adjustable round top as follows:

1. Nickel-Bronze Top: Manufacturer's standard cast unit with the following patterns:
   a. Exposed rim type, with recess to receive 1/8 inch thick resilient floor finish.
   b. Exposed rim type, with recess to receive 1 inch thick terrazzo floor finish.
   c. Exposed finish type, standard mill finish.
   d. Exposed flush type, standard non-slip scored or abrasive finish.

2. Cast-iron Top: Manufacturer's standard cast unit with the following patterns:

a. Exposed flush type, standard mill finish.
b. Exposed flush type, standard non-slip scored or abrasive finish.

F. Wall Cleanouts: Cast-iron body adaptable to pipe with cast-bronze or brass cleanout plug; stainless steel cover including screws.

G. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.

H. Vent Flashing Sleeves: Cast-iron calking type roof coupling for cast-iron stacks, cast-iron threaded type roof coupling for steel stacks, and cast-bronze stack flashing sleeve for copper tubing.

I. Frost-Proof Vent Caps: Construct of galvanized iron, sized to provide 1 inch air space between outside of vent pipe and inside of flashing collar extension.

J. Vandal-Proof Vent Caps: Cast-iron body full size of vent pipe, with calked base connection for cast-iron pipes, threaded base for steel pipes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.

B. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

C. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

A. Install copper tube with cast bronze fittings for 3 inch and smaller, drainage and vent pipe.

B. Install hub-and-spigot, service weight, cast-iron soil pipe with lead and oakum calked joints for larger than 3 inch drainage and vent pipe.

C. Install hub-and-spigot, service weight, cast-iron soil pipe with compression gasket joints for larger than 3 inch drainage and vent pipe.

D. Install hubless, service weight, cast-iron soil pipe and fittings for larger than 3 inch drainage and vent pipe.

3.3 PIPE AND TUBE JOINT CONSTRUCTION

A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."

B. Cast-Iron Soil Pipe: Make lead and oakum calked joints, compression joints, and hubless joints in accordance with the recommendations in the CISPI Cast Iron Soil Pipe and Fittings Handbook, Chapter IV.

3.4 INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as required.

B. Use fittings for all changes in direction and all branch connections.

C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors.

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

G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal.

H. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity.

I. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

J. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment required with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

K. Install building drain pitched down at minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger.

L. Extend building drain to connect to sewer piping, of size and in location required for service entrance to building.

M. Install sleeve and mechanical sleeve seal through foundation wall for watertight installation.

N. Install 1 inch thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12" beyond each side of pipe. Install directly over, and center on pipe center line.

O. Insulate all waste stacks for their entire length, and continue over fittings etc.

3.5 HANGERS AND SUPPORTS

A. General: Hanger, supports, and anchors devices are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes as required by current International Plumbing Codes and requirements of Governing Authorities:

3.6 INSTALLATION OF PIPING SPECIALTIES

A. Install backwater valves in sanitary building drain piping as required, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.

B. Install expansion joints on vertical risers as required, and as required by the plumbing code.

C. Above Ground Cleanouts: Install in above ground piping and building drain piping as required, and:

1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
4. at base of each vertical soil or waste stack.

D. Cleanouts Covers: Install floor and wall cleanout covers for concealed piping, types as required.

E. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.

F. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

G. Frost-Proof Vent Caps: Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1 inch clearance between vent pipe and roof substrate.

3.7 CONNECTIONS

A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes; but in no case smaller than required by the plumbing code.

B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.8 FIELD QUALITY CONTROL

A. Inspections

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
   a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
   b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.

3. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.

4. Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
4. Finished Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight.

Plug the stack openings on the roof and building drain where it leaves the building, and introduce air into the system equal to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.

5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Prepare reports for all tests and required corrective action.

3.9 ADJUSTING AND CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.10 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops

END OF SECTION 22 13 16

SECTION 22 42 00 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes plumbing fixtures and trim, fittings, and accessories, appurtenances, and supports associated with plumbing fixtures.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 22 Section "Drainage and Vent Systems".
2. Division 22 Section "Valves" for valves used as supply stops.
3. Division 22 Section "Water Distribution Piping".

1.2 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of plumbing fixture as scheduled on drawings, including fixture and trim, fittings, faucets, accessories, supports, construction details, dimensions of components, flow rates of fixtures, and finishes.

1.3 QUALITY ASSURANCE

A. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Engineer. Burden of proof for equality of plumbing fixtures is on the proposer.

B. Codes and Standards: As specified in Section 23 05 00.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.

B. Store plumbing fixtures on elevated platforms in a dry location.

1.5 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.
1. Faucet Washers and O-rings: Furnish quantity of identical units not less than 10 percent of amount of each installed.
2. Faucet Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed.

3. Water Closet Repair Kits: Furnish quantity of identical flush valve units not less than 5 percent of amount of each type installed.
4. Toilet Seats: Furnish quantity of identical units not less than 5 percent of amount of each type toilet seat installed.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES, GENERAL

A. Fixtures shall be in accordance with specifications and scheduled on the drawings.

B. Flow rates shall comply with EPA WaterSense where applicable.

C. Provide air chambers at all fixtures.

2.2 FAUCETS

A. Faucets General: Unless otherwise specified, provide faucets that are cast brass with polished chrome-plated finish.

2.3 FITTINGS, EXCEPT FAUCETS

A. Fittings General: Unless otherwise specified, provide fittings fabricated of brass, with a polished chrome plated finish.

B. Sink Supplies and Stops: Handle angle stop, having 1/2-inch NPS inlet with wall flange and 1/2-inch by 12-inch flexible tubing riser outlet.

C. Sink Traps: Cast brass, 1-1/2 inch NPS adjustable P-trap with cleanout, 17 gage tubular waste to wall, and wall flange.

D. Sink Continuous Wastes: Polished chrome-plated, tubular brass, 1-1/2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.

E. Escutcheons: Polished chrome-plated, sheet steel wall flange with friction clips.

F. Deep Pattern Escutcheons: Wall flange with set screw or sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing-in fittings.

G. Provide fittings specified as part of a fixture description, in lieu of fitting requirements above.

2.4 PLUMBING FIXTURE SUPPORTS

A. Supports: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.

B. Support categories are:

1. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.
2. Reinforcement: 2-inch by 4-inch wood blocking between studs or 1/4-inch by 6-inch steel plates attached to studs, in wall construction, to secure floor-mounted and special fixtures to wall.

C. Support Types: Provide support of category specified, of type having features required to match fixture.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.

B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:

3.3 INSTALLATION OF PLUMBING FIXTURES

A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.

B. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.

C. Fasten wall hanging plumbing fixtures securely to supports attached to building substrate.

D. Secure supplies behind wall or within wall pipe space, providing rigid installation.

E. Install stop valve in an accessible location in each water supply to each fixture.

F. Install trap on fixture outlet except for fixtures having integral trap.

G. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.

H. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other sections of Division 15. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22.

3.5 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.6 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

C. Replace washers of leaking and dripping faucets and stops.

D. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

E. Review the data in Operating and Maintenance Manuals.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities, except when approved in writing by the Owner.

3.8 FIXTURE SCHEDULE

A. Provide plumbing fixtures as scheduled on the drawings.

END OF SECTION 22 42 00

SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. General: Materials and methods for performance of all mechanical work.

B. Provide complete and operational mechanical systems including, but not limited to, all required materials, parts, equipment, labor, tools, and accessories.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for mechanical installations.

1. Codes & standards.
2. Submittals.
3. Quality control.
4. Permits, fees, and inspections.
5. Schedule and sequence.
6. Project and site conditions.
7. Delivery, storage, and handling.
8. Record documents.
9. Operation and Maintenance manuals.
10. Warranties and guaranties.
11. Rough-ins.
12. Mechanical installations.
13. Cutting, patching, and firestopping.
14. Mechanical indentification.

1.3 CODES AND STANDARDS

A. Except as modified by governing codes, comply with applicable provisions and recommendations of the following:

1. ANSI Standards.
2. Owner's Insurance Company.
3. Current Connecticut Laws and Statutes.

1.4 SUBMITTALS

A. Increase, by the quantity listed below, the number of mechanical related shop drawings, product data, and samples submitted, to allow for required distribution.

1. Shop Drawings: Initial Submittal: 1 additional blue- prints.
2. Product Data: 1 additional copy of each item.
3. Samples: 1 addition as set.

B. Additional copies may be required by individual sections of these Specifications.

C. Shop Drawings:

1. Submit for review, detailed shop drawings and product data of all the equipment and material required to complete the work. No material or equipment may be delivered to the jobsite or installed until accepted shop drawings for the particular material or equipment have been approved by the Owner or his authorized representative.
2. Failure to submit shop drawings in ample time for checking will not entitle Contractor to claim extension of Contract time, or increase in contract cost.
3. The proposed piping layout for the Boiler system is required.
4. The proposed ductwork layout for the RTUs/AHUs is required.

D. Tests & Certificates:

1. As specified in other sections.

1.5 QUALITY ASSURANCE

A. Drawings:

1. Drawings are diagrammatic. They indicate the general arrangement of systems and work included in the contract. Drawings are not to be scaled. Site and Architectural drawings and details shall be examined for exact location of fixtures and equipment. Where they are not definitely located, this information shall be obtained from the Owner or authorized representative.
2. Surveys and Measurements:
   a. Before submitting bid, visit site, become familiar with conditions under which work will be installed. Contractor will be held responsible for assumptions, omissions, and errors made as a result of failure to become familiar with site and contract documents.
   b. Base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with established lines and levels. Verify all measurements at site and check the correctness of same.
   c. Notify the Engineer promptly of discrepancies between actual measurements and those indicated, which prevents following good practice or intent of drawings and specifications. Do not proceed with work until Contractor has received instructions from Engineer.

B. Labor:

1. Cooperation with Other Trades:
   a. Give full cooperation to other trades; furnish in writing to General Contractor, with copies to the Engineer, information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
   b. Where work will be installed in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment. If directed by the Engineer, prepare composite working drawings and sections at a suitable scale not less than 1/4" = 1'0", clearly showing how work is to be installed in relation to the work of other trades. If work under this division is installed before coordinating with other trades, or to cause any interference with work of other trades, make necessary changes to correct the condition without additional cost.
   c. Furnish to other trades all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

2. Materials & Workmanship:
   a. Materials and apparatus required for the work shall be new and of first class quality. Furnished, delivered, erected, connected and finished in every detail. Select and arrange to fit properly into the building spaces. Where no specific kind or quality of material is given, furnish first class standard article as accepted by Engineer.
   b. Furnish the services of an experienced superintendent who shall be in constant charge of the work, together with skilled craftsmen and labor required to unload, transfer, erect, connect-up, adjust, start, operate, and test each system.
   c. All equipment and materials to be installed with the acceptance of the Engineer in accordance with the recommendations of the manufacturer. This includes the performance of such test as the manufacturer recommends.

3. Protection of Materials:
   a. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

   b. Welding: Before any welding is performed, submit a copy of the Welding Procedure Specification (WPS) together with the Procedure Qualification Record a required by Section IX of the ASME Boiler and Pressure Vessel Code.

      1) Before any welder performs any welding, submit a copy of the Manufacturer's Record of Welder or Welding Operator Qualification

Tests as required by Section IX of the ASME Boiler and Pressure Vessel Code. The letter or symbol (as shown on the qualification test form) shall be used to identify the work of that welder and shall be affixed, in accordance with appropriate construction code, to each completed weld.

2) The types and extent of non-destructive examinations required for pipe welds are shown in Table 136.4 of the Code for Pressure Piping, ASNI/ASME B31.1.

c. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Engineer prior to the installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.6 PERMITS, FEES, & INSPECTIONS

A. Give all necessary notices, obtain and pay for all permits, and pay all government sales taxes, fees, and other costs, including utility connections or extensions in connection with work. File necessary approvals of governmental departments having jurisdiction. Obtain required certificates of inspection for work and deliver a copy to the Owner or his authorized representative before requesting acceptance for final payment.

1.7 SCHEDULE & SEQUENCE

A. Temporary Services:

1. Refer to the General Conditions and Special Conditions for a full description of the temporary services to be provided.

B. Temporary Openings:

1. Ascertain from examination of the drawings any special temporary openings in the building required for the admission of apparatus provided under this Division. Notify the Owner accordingly. Contractor shall assume all costs of providing such openings thereafter.

C. Sequencing:

1. Contractor shall coordinate sequence of work with owner's representative.

1.8 PROJECT & SITE CONDITIONS

A. Cutting, Patching, and Firestopping:

1. Furnish all cutting, drilling and patching. Furnish sketches showing the locations and sizes of openings, chases, etc., required for the installation of work. Furnish the Contractor with an approximation of the number and size of openings, chases, etc., required.

B. Waterproofing:

1. Where any work pierces existing waterproofing, re-waterproof. The method of installation to be reviewed by Owner or his authorized representative before work is done. Furnish all sleeves, caulking, and flashing required to make openings watertight.

C. Fireproofing:

1. Where any work penetrates a fire rated assembly, provide UL listed, firestopping with hourly rating equal to that of the penetrated assembly. Fireproofing shall be compatible with the pipe or equipment doing the penetration so that fire rating of the assembly is maintained.

1.9 DELIVERY, STORAGE, & HANDLING

A. Delivery & Receipt:

1. Contractor is responsible for the delivery and storage of all materials, parts, equipment, etc. required for this project.

B. Storage:

1. The Contractor shall store all material, parts, and equipment required for this project in accordance with supplier's and manufacturer's recommendations, and Owner's requirements.

C. Handling, Hoisting, Rigging, & Scaffolding:

1. Furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished under this Division. Remove same from premises when no longer required.

1.10 RECORD DOCUMENTS

A. Maintain at the job site a record set of drawings on which any changes in location of equipment, piping, ducts, valves, cleanouts, panels, and major conduits shall be

recorded. These shall be clearly marked on a clean set of prints at the completion of work for record drawings and turned over to the Owner.

B. Prepare record documents in accordance with the requirements below:

1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, tanks, etc.). Valve location diagrams, complete with valve tag chart.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
4. Contract Modifications, actual equipment and materials installed.

1.11 OPERATION & MAINTENANCE MANUALS FOR MECHANICAL SYSTEMS

A. Bind Operation & Maintenance Manual for Mechanical System in a hard-backed binder.
1. Provide a master index at beginning of Manual showing items included. Use plastic tab indexes for sections of Manual.
2. First section shall consist of name, address, and phone number of Architect, Mechanical & Electrical Engineers, General Contractor and Mechanical, Plumbing, Sheet Metal, Refrigeration, Temperature Control & Electrical Contractors. Also include a complete list of equipment installed with name, address, and phone number of vendor.
3. Provide section for each type of item of equipment.
4. Submit three copies of Operation & Maintenance Manual to Engineer for his approval. Use one of these approved copies during final inspection and leave with building maintenance personnel.

B. Include descriptive literature (Manufacturer's catalog data) of each manufactured item. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.

C. Operating instructions shall include:

1. General description of each mechanical system.
2. Step by step procedure to follow in putting each piece of mechanical equipment into operation.
3. Provide schematic control diagrams for each separate fan system, refrigeration system, heating system, control panel, etc. Each diagram shall show locations of start-stop switches, insertion thermostats, room thermostats, thermometers,

firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark correct operating setting for each control instrument on these diagrams.

4. Provide diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlock, electrical switches, and relays.
5. Provide drawing of each temperature control panel system.

D. Prepare maintenance manuals to include the following information for equipment items:

1. Manufacturer's maintenance equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers & lists, operation instructions of equipment and maintenance & lubrication instructions.
2. Summary list of mechanical equipment requiring lubrication showing name of equipment, location and type, and frequency of lubrication.
3. List of mechanical equipment used indicating name, model, serial number, and name plate data of each item together with number and name associated with each system item.
4. List spare parts and quantities to be maintained in ready inventory at project site.
5. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
6. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
7. Servicing instructions and lubrication charts and schedules.

E. Air Balance and Water Balance Test Run Reports

1.12 WARRANTIES AND GUARANTIES

A. Guarantee all material and workmanship under this Division for a period of one year, from the date of final acceptance by the Owner.

B. During guarantee period, all defects developing through materials and/or workmanship shall be replaced immediately without expense to the owner. Make such repairs or replacements to the satisfaction of the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. As specified under other related sections.

B. As specified on drawings.

2.2 MATERIALS

A. As specified under other related sections.

B. As specified on drawings.

2.3 EQUIPMENT DEVIATIONS

A. Where the Contractor proposed to use an item of equipment other than that specified or detailed on the drawings which requires the redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical layout, all such redesign, and all new drawings and detailing required therefore, shall be prepared at the Contractor's expense and are subject to the review and approval of the Engineer. Owner reserves the right to have the Engineer prepare any redesign work.

B. Where such accepted deviation requires a different quantity and arrangement of materials or equipment from that specified or indicated on the drawings, the Contractor will provide additional equipment and materials required at no additional cost to the Owner.

C. When equipment or methods deviate from original plans or specifications, the Contractor must submit a written request to deviate to the Engineer. At a minimum the request will address the following:

- equipment which is different than specified
- name and data related to the proposed deviation
- reason for deviation
- advantageous or disadvantageous to the Owner
- credit or increase in cost to the Owner
- guarantees or warranties offered (if any)
- acceptance of liability for equivalent performance.

2.4 MANUFACTURER'S IDENTIFICATION

A. Attach manufacturer's nameplate, name, trademark and address permanently to equipment and material furnished under this Division. Nameplate of a Contractor or Distributor is not acceptable.

2.5 ELECTRICAL REQUIREMENTS

A. Motors:

1. Electric motors furnished as a component part of equipment furnished under this Division shall conform to the requirements of IEEE, NEMA, UL, ANSI C50, and ANSI CI. Motors to be suitable for required load, duty voltage, phase, frequency, service and location.
2. Motors to be suitable for continuous duty at rated horsepower with temperature rise not to exceed 40oC for dripproof motors, 50oC for splashproof motors, and 55oC for totally enclosed motors. Motors to be capable of withstanding momentary overloads of 25 percent without injurious overheating.
3. Motors to have nameplates giving Manufacturer's name, serial number, horsepower, speed and current characteristics.
4. Motor leads shall be permanently identified and supplied with connectors.
5. Each motor to be selected for quiet operation in accordance with NEMA standards.

B. Motor Starters:

1. Electric motor starters shall conform to requirements of IEEE, NEMA, UL, ANSI, CI and shall be suitable for the required load, duty, voltage, phase, frequency, service, and location.
2. When interlocking or automatic control of single phase motors is required, motors to be furnished with full voltage, across-the-line starters.

C. Connections:

1. All wiring to be furnished and installed under Division 16.

2. Power wiring to be furnished and installed complete from power source to motor or equipment junction box, including power wiring through the starters. Starters not factory mounted on equipment shall be furnished and installed under Division 16.

2.6 MECHANICAL REQUIREMENTS

A. Bases & Supports:

1. Provide necessary foundations, supports, pads, bases and piers required for equipment, tanks, and other equipment furnished under this Division. Submit drawings to Engineer for review before purchase, fabrication, or construction.
2. Construction of foundations, supports, pads, bases, and piers where mounted on the floor to be of the same materials and same quality of finish as the adjacent surrounding flooring material.

B. Lubrication:

1. Lubricate all equipment having moving parts and requiring lubrication according to manufacturer's recommendations prior to testing and operation.

Equipment discovered to have been operated before lubrication is subject to rejection and replacement at no cost to the Owner.

C. Accessibility:

1. Be responsible for the sufficiency of the size of shafts and chases, adequate clearance in double partitions and hung ceilings for proper installation of work. Cooperate with the Contractor and other contractors whose work is in the same space. Advise the Contractor of requirements. Such spaces and clearances shall be kept to the minimum size required.
2. Locate all equipment which requires servicing in fully accessible positions. Equipment shall include but not be limited to, valves, traps, clean-outs, motors, controllers, switchgear, and drain points. Any change shall be submitted to the Owner or his authorized representative for review.

D. Connection to Existing Structures:

1. Before cutting, drilling, attaching, or any work involving building elements, coordinate work with others and Owner to avoid damage to building elements.

2.7 FIRESTOPPING

A. Firestopping shall be UL listed, and tested in accordance with ASTM E814, E119, and E84.

B. Hourly rating shall be equal to that of the assembly being penetrated.

C. Firestopping shall be compatible with pipe or equipment penetrating the assembly fire rating of the assembly must be maintained.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications for rough-in requirements.

3.2 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 CUTTING, PATCHING, AND FIRESTOPPING

A. General: Perform cutting and patching in accordance with the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Remove and replace defective Work.
2. Remove and replace Work not conforming to requirements of the Contract Documents.

3. Remove samples of installed Work as specified for testing.
4. Install equipment and materials in existing structures.
5. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

1. Patch finished surfaces and building components using materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

E. Firestop all pipe and equipment that penetrates fire rated assembly. Follow manufacturer's instructions to provide fire rating equal to that of the assembly.

3.4 FIELD QUALITY CONTROL

A. Perform field tests as specified under other sections.

B. Arrange for local inspection authorities to inspect work performed prior to burial, closing-in behind wall and above ceiling or encase in concrete. Also arrange for final inspection of work and obtain Final Inspection Certificate before final inspection by Owner or his representative.

3.5 PAINTING

A. Materials shipped to the job site under this Division to have prime coat and standard manufacturer's finish.

3.6 TESTING & BALANCING: See Section 230593

3.7 EQUIPMENT IDENTIFICATION

A. Valves charts and tags

1. All valves shall be provided with valve tags secured to the valve stems or handles with brass chains or S hooks. Tags shall be based on Seton Nameplate Co. (Numbers and letter identification shall indicate service where valve is located. Tags shall be 1-3/8" diameter.

2. Furnish two (2) valve charts, one framed under glass and one unframed copy for record files. Charts shall indicate system designation, valve number, service, and location of valve. Use actual room names on charts.

3.8 CLEANING

A. Any part of a system stopped by foreign matter after being placed in operation, to be disconnected, cleaned, and reconnected to locate and remove obstructions. Work damaged in the course of removing obstructions will be repaired or replaced at no additional cost to the Owner.

B. Cap all pipes to protect against entrance of foreign matter.

C. Remove rubbish, debris, and excess materials. Remove oil and grease stains on floor areas.

END OF SECTION 23 05 00

SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPE AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Division 23 Sections apply to this section:

1. "Common Work Results for HVAC."

1.2 SUMMARY

A. This section includes the following:

1. Horizontal-piping hangers and supports.
2. Vertical-piping clamps.
3. Hanger-rod attachments.
4. Building attachments.
5. Saddles and shields.
6. Spring hangers and supports.
7. Miscellaneous materials.
8. Equipment supports.

B. Related sections: The following sections contain requirements that relate to this section:

1. Division 23 Section "HVAC Piping Insulation"

1.3 DEFINITIONS

A. Terminology used in this section is defined in MSS SP-90.

1.4 SUBMITTALS

A. General: Submit the following in accordance with conditions of contract and Division specification sections.

1. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
2. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
3. Assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Regulatory Requirements: Comply with applicable plumbing code pertaining to product materials and installation of supports and anchors.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 and MSS SP-69.

1. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

2.2 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substates and conditions under which supports and anchors are to be installed. Do not proceed with installing until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69 and SP-89. Install supports with maximum spacings complying with Boca Plumbing and Mechanical Codes. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.

B. Install building attachments within concrete or 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, expansion joints, and at changes in direction of piping.

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

D. Install hangers and supports to allow controlled 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.

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

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.

G. Insulated Piping: Comply with the following installation requirements.

1. Shields: Install protective shields MSS Type 40 on cold water piping that has vapor barrier. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

NPS	LENGTH	THICKNESS
1/4 THROUGH 3-1/2	12	0.048
4	12	0.060

2. Insert material shall be at least as long as the protective shield.
3. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.3 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.4 ADJUSTING

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

END OF SECTION 23 05 29

SECTION 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The work of this section includes but is not limited to the following:

1. Vibration isolation elements.
2. Equipment isolation bases.
3. Piping flexible connections.
4. Seismic restraints for isolated and non-isolated mechanical and electrical items.

1.2 REFERENCES

A. State of Connecticut Building Code.

B. NFPA 13 - Installation of Sprinkler Systems.

C. ASHRAE-A Practical Guide to Seismic Restraint.

D. Mason Industries, Inc. Seismic Restraint Guidelines

1.3 QUALIFICATIONS

A. Qualifications: Only firms having five years experience designing and manufacturing seismic devices shall be capable of work in this specification.

1.4 SUBMITTALS

A. The submittal material shall include copies of descriptive data for all products and materials including but not limited to the following:

1. Descriptive Data:

a. Catalog cuts and data sheets.
b. An itemized list showing the items to be isolated and/or seismically restrained, product type or model number to be used and loading and deflection data.
c. Seismic restraint calculations.
d. (Structural or civil engineer’s State of Connecticut professional engineer’s seal verifying design and calculations for seismic restraining system used.)

2. Shop Drawings:

a. Drawings showing equipment base construction for each machine, including dimensions, structural member sizes, and support point locations.
b. Drawings showing methods of suspension, support guides for conduit, piping and

ductwork.

c. Drawings showing methods for isolation of conduits, pipes and ductwork penetrating walls and floor slabs.
d. Concrete and steel details for bases including anchor bolt locations.
e. Number location of seismic restraints and anchors for each piece of equipment.
f. Specific details of restraints including anchor bolts for mounting and maximum loading at each location, for each piece of equipment and/or pipe and duct

1.5 GENERAL (MANUFACTURER) RESPONSIBILITIES

A. Design Builder shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations per specifications.
2. Provide and install isolation systems and seismic restraints as scheduled or specified.
3. Guarantee specified isolation system deflection.
4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
5. Substitution of “Internally Isolated” mechanical equipment in lieu of the specified isolation of this section may be acceptable provided that all specified deflections and stamped seismic calculations are supplied by the equipment manufacturer.

1.6 PROJECT RECORD DOCUMENTS

A. Record actual locations and installation of vibration isolators and seismic restraints including attachment points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Mason Industries Inc. models listed below.

2.2 SEISMIC RESTRAINT TYPES

A. General: Installations shall be designed to safely accept external forces of one-half “G” load in any direction for all rigidly supported equipment without failure and permanent displacement of the equipment. Life safety equipment such as (fire pumps, sprinkler piping and emergency generators) shall be capable of safely accepting external forces up to one “G” load in any direction without permanent displacement of the supported equipment. Seismic restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise.

B. Type II (snubber): Each corner of side shall incorporate a seismic restraint having a minimum 5/8” thick resilient pad limit stops working in all directions. Restraints shall be made of plate, structural members, or square metal tubing concentric within a welded assembly incorporated resilient pads. Angle bumpers are not acceptable. System to be field bolted or welded to a

deck with 1 G acceleration capability. Mason Type Z-1011 and Z-1225.

C. Type III (cable braces): Metal cable type with approved end fastening devices to equipment and structure. System to be field bolted to deck or overhead structural members using two sided beam clamps to steel or appropriately designed insert for concrete. All parts of system including cables, clamps, excluding fastenings are to be single vendor furnished to assure seismic compliance. Mason Type SCB.

D. Type V: Non-isolated equipment to be field bolted or welded (powder shots not acceptable) to resist seismic forces unless under 100 lb. Shear force required. Mason Type SAS, SAB.

2.3 VIBRATION ISOLATION - GENERAL

A. Vibration Isolation shall control excessive noise and vibration in the building due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork, or conduit. (The installation of all vibration isolation units, and associated hangers and bases, shall be under the direct supervision of the vibration isolation manufacturer's representative.)

B. All vibration isolators shall have either known non-deflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection can be verified.

C. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.

D. The theoretical vertical natural frequency for each support point, bases upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than +/- 10%.

E. All neoprene mountings shall have a Shore hardness of 30 to 60 +/- 5, after minimum aging of 20 days or corresponding oven aging.

2.4 VIBRATION ISOLATOR TYPES:

A. Type E: Elastomer hanger rod isolators:

1. Molded unit type neoprene element with projecting bushing lining rod clearance hole.
2. Neoprene element to be minimum 1-3/4" thick.
3. Steel retainer box encasing neoprene mounting.
4. Clearance between mounting hanger rod and neoprene bushing shall be minimum of 1/8".
5. Minimum static deflection of 0.35".
6. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
7. Mason Type HD.

B. Type F: Combination spring/elastomer hanger rod isolators:

1. Spring and neoprene isolator elements in a steel box retainer. Neoprene double deflection type. Single deflection is unacceptable. Spring seated in a neoprene cup with extended rod bushing.
2. Characteristics of spring and neoprene as described in Type A and Type E isolators.
3. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
4. Mason Type DNHS.

C. Type G: Pad type elastomer mountings:

1. ¾" Minimum thickness.
2. 50 PSI maximum loading.
3. Waffled design.
4. Deflection per pad thickness.
5. Galvanized steel plate between multiple layers or pad thickness.
6. Suitable bearing plate to distribute load.
7. Mason Type Super W.

D. Type H: Grommet type elastomer bushings:

1. One piece molded bridge bearing neoprene.
2. Washer / bushing shall surround the anchor bolt.
3. Flat washer face to avoid metal to metal contact.
4. Mason type HG.

E. Type K: Pipe Anchors: All-directional acoustical pipe anchor consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum one-half inch thickness of heavy-duty neoprene and duck or neoprene isolation material. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction.

Allowable loads on the isolation material travel in either direction. Allowable loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction. Isolation to be bolted or welded depending on structure. Mason Type ADA.

2.5 EQUIPMENT BASES

A. Integral Structural Steel Base, Type B-1:

1. Reinforced as required to prevent base flexure at start-up and misalignment of drive and driven units. Centrifugal fan bases complete with motor slide rails.
2. Drills for drive and driven unit mounting template.
3. Must be utilized with seismic restraint Type I, II, or IV.
4. Mason Type M, WFB.

B. Concrete Inertia Base, Type B-2:

1. Vibration isolator manufacturer shall furnish rectangular structural concrete forms for floating foundation. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth shall be a minimum of 1/10 of the longest dimension of the base but not less than 6" or greater than 14". Forms shall include minimum concrete reinforcement consisting of ½"bars or angles welded in place in 6" centers running both ways in a layer 1-1/2" above the bottom and a top layer of reinforcing
2. steel as above for all bases exceeding 120" in one direction. Isolators shall be set into pocket housings which are an integral part of the base construction and set at the proper height to maintain a 1" clearance below the base. Bases shall be furnished with templates and anchor bolt sleeves as part of this system.
3. Must be utilized with seismic restraint Type I, II or IV.
4. Mason Type K, BMK.

C. Isolated Curb, Type B-3:

1. Curb mounted rooftop equipment shall be mounted on structural spring isolation curbs that directly sit on roof construction and are flashed and waterproofed into roof's membrane waterproofing system. Manufacturer's curb shall not be used.
2. All spring locations shall have removable waterproof covers to allow for spring adjustment and/or removal.
3. Curbs shall have a provision for an optional sound barrier kit
4. All spring mounts shall be as Isolator Type A.
5. Curbs shall have static deflection as detailed on the isolation / seismic schedule
6. Curbs shall be rated for 1 G of acceleration and shall be wind restrained for 110 mph wind loads.
7. Curbs shall have California OSHPD approval.
8. Sound barrier package, SBC-3. Two layers of waterproof sheetrock shall be supplied and installed by Design Builder.
9. Curbs to be welded to building steel or bolted to concrete decks to attain acceleration criteria.
10. Mason Type RSC.

D. Roof Isolation Rail System, Type B-4: Rooftop fans, condensing units, exterior ducted handling units, etc., shall be installed on continuous equipment support piers which shall combine a regular equipment support and an isolation system into one assembly. The system shall be designed with 2" or 3" static deflection steel springs which are both djustable, removable, and interchangeable after equipment has been installed. The system shall maintain the same operating and installed height both with and without the equipment load and shall be fully restrained during wind load conditions allowing no more than ¼" motion in any direction. The isolation pier shall be designed to accept the membrane waterproofing. The entire assembly shall be cold spray galvanized or plastic coated. System design permits minimum 1 G of acceleration. Curbs to be welded to building steel or bolted to concrete decks to attain acceleration criteria. Mason Industries Model RSR.

E. Non-isolated seismic roof curbs, Type B-5:

1. Curb sections shall be either structural steel channels or 12GA. sheet metal

2. Field assembled joints shall include a minimum of 2 rows of three bolts at each connection.
3. Curb to have a factory installed wood nailer.
4. System to be bolted or welded to deck.
5. System shall be designed for minimum 1/2G. of acceleration.
6. Mason Type RRC.

F. Dunnage steel mounted rooftop equipment. Type B-6:

1. Rooftop equipment shall be mounted on structural tubular steel boxed rail assembly.
2. Tubular steel rails shall be attached to seismic rated spring vibration isolators.
3. Isolators shall be bolted or welded to dunnage steel to meet seismic criteria of 1/2G acceleration.
4. Entire assembly shall be hot dipped galvanized.
5. Mason Type RSLR.

2.6 FLEXIBLE CONNECTORS

A. Elastomer Type FC-1:

1. Manufactured of Kevlar reinforcement and EPDM, both molded and cured with hydraulic presses.
2. Straight connectors to have two spheres reinforced with a molded-in external ductile iron ring between spheres.
3. Elbows shall be long radius type.
4. Rated 250 psi at 170 degrees F. Dropping in a straight line to 170 psi at 250 degrees F for sizes 1-1/2" to 12" elbows. Elbows shall be rated no less than 90% of straight connections.
5. Sizes 10" to 12" to employ control cables with neoprene end fittings isolation from anchor plates by means of ½"
6. bridge bearing neoprene bushings.
7. Minimum safety factor, 4:1 at maximum pressure ratings.
8. Systems bolted to victaulic type couplings or gate, butterfly, or check valves to have a minimum 5/8" flange spacer installed between conductor and coupling on flange.
9. Submittals to include test reports.
10. Mason Type Safeflex SFDEJ.

B. Flexible Stainless Hose, Type FC-2:

1. Type 321 stainless steel braided flexible metal hose.
2. 2" pipe size and smaller: threaded carbon steel fittings.
3. 1-1/2" pipe size and larger: Class 150 carbon steel flanges.
4. Suitable for operating pressure with 4:1 minimum safety factor.
5. Flexible Metal Hose Company type DFC and MFC.

C. Unbraided Exhaust Hose, Type FC-3:
1. Low pressure stainless steel annularly corrugated.
2. Fitted with flanged ends.

3. Maximum temperature 1,500 degrees F.
4. Mason Type SDL-RF.

PART 3 - EXECUTION

3.1 GENERAL SEISMIC RESTRAINT REQUIREMENTS

A. Install seismic restraints in accordance with manufacturers recommendations.

B. Seismic restraining system Type III: Install taut for non-isolated equipment and slack with ½" cable deflection for isolated systems.

C. Seismically restrain all piping, conduit and ductwork with Type III or Type V seismic restraint in accordance with guidelines outlined below. Restraints which are to be used in conjunction with vibration isolators shall be Type III.

1. Carbon steel piping shall be braced at maximum 40' intervals and at turns of more than 4'. Lateral bracing at maximum 80' intervals. No-hub piping to be braced at maximum 20□ intervals or maximum 40" using 1/2 G acceleration rated couplings.
2. Ductwork shall be braced at maximum 30' and at every turn and duct run end. Lateral bracing at maximum 60'.

D. Equipment mounted on housekeeping pads: Pads shall be properly doweled or expansion shielded to deck to meet acceleration criteria. Mason Type HPA.

E. Seismic Restraints are not required for the following:

1. Piping in boiler or mechanical rooms or penthouses less than 1-1/4" O.D. except gas piping and fire protection piping.
2. Piping in other areas less than 2-1/2" O.D., except gas piping and fire protection piping.
3. Ducts which have a cross sectional area less than 6 square feet.
4. All piping suspended by individual hanger 12" or less in length from the top of the pipe to the bottom of the support for the hanger, except gas piping and fire protection piping.
5. Fire protection feed mains and cross mains suspended by individual hangers 6" or less in length from the top of the pipe to the bottom of the support for the hanger.
6. All top supported ducts suspended by hangers 12" or less in length from the top of the duct to the bottom of the support for the hanger.
7. Electrical conduit less than 1-1/2" I.D.

F. (Chimneys and stacks passing through floors are to be bolted at each floor level or secured above and below each floor with riser clamps.)

G. (Chimneys and stacks running horizontally to be braced every 30' with Type III restraining system.)

H. For overhead supported equipment, over stress of the building structure must not occur. Bracing can occur from:

1. Flanges to structural beams.
2. Upper or lower truss chords in bar joist construction at panel points.
3. Cast-in-place inserts or drilled and shielded inserts in concrete structures.

I. Building seismic expansion joints: Install hinged joints at piping crossing expansion joints and anchor the piping either side per the detail provided on the contract drawings. Anchors on each end are to be capable of accepting 1.5 times the operating pressure multiplied by the projected area of the pipe. Offset shall be accomplished by the annular motion of a double sphere connector (TYPE FC-1) bolted to each end of an intermediate steel pipe. Bracket each joint with hinged steel connections. Hinges shall have a pin / slot assembly on both sides. The completed assembly shall be Mason Type Safeflex SFDEJ-HE.

3.2 GENERAL VIBRATION ISOLATION REQUIREMENTS

A. Install isolators in accordance with manufacturer's recommendations. Vibration isolators shall not cause any change of position resulting in stresses or misalignment.

B. Mechanical equipment shall be isolated from the building structure by means of noise and vibration isolators.

C. Each fan and motor assembly shall be supported on a single structural steel frame (where noted on the isolation and seismic schedule). Flexible duct connections shall be provided at inlet and discharge ducts.

D. Provide pairs of horizontal limit springs (Thrust restraints) on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans where indicated

E. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch (1.5 mm) maximum clearance. Other snubbers shall have clearance between 0.15 inch (4 mm) and 0.25 inch (7 mm).

F. Installation of piping vibration isolators:

1. All piping, except fire protection standpipe systems, is included under this section.
2. Vibration isolators shall be installed on all piping outside the shafts as follows:

   a. Piping in boiler or mechanical rooms.
   b. Piping where exposed on roof.
   c. Piping connected to rotating equipment and pressure reducing stations.

3. Horizontal suspended pipe 2" and smaller and all steam piping shall be suspended by Type E isolator with a minimum 3/8" deflection. Water pipe larger than 2" shall be supported by Type C or Type F isolator with minimum 1" whichever is greater.
4. Horizontal pipe floor supported at slab shall be supported via Type A with a minimum static deflection of 1" or same deflection as isolated equipment to which pipe connects, whichever is greater.

5. Vertical riser pipe supports under 2" diameter shall utilize Type G isolation pads.
6. Vertical riser guides, if required, shall avoid direct contact of piping with building.
7. Pipe anchors or guides, where required, shall utilize resilient pipe anchors, Mason Industries Type ADA, or equivalent, to avoid direct contact of piping with building.
8. Isolated piping which requires sway bracing shall utilize two neoprene elements, Type G to accommodate tension and compression forces.
9. Pipe extension and alignment connectors: Provide connectors at riser takeoffs, cooling and heating coils, and elsewhere as required, to accommodate thermal expansion and misalignment.

G. Pipe Isolation Schedule

PIPE SIZE - INCH (MM)	ISOLATED DISTANCE FROM EQUIPMENT
1 (25)	120 diameters (3.0m)
2 (50)	90 diameters (4.5m)
3 (80)	80 diameters (6.0m)
4 (100)	75 diameters (7.5m)
6 (150)	60 diameters (9.0m)
8 (200)	60 diameters (12.0m)
10 (250)	54 diameters (13.5m)
12 (300)	50 diameters (15.0m)
16 (400)	45 diameters (18.0m)
24 (600)	38 diameters (23.0m)

3.3 EQUIPMENT INSTALLATION

A. Requirements for installation on concrete inertia bases shall be as follows:

1. Minimum operating clearance between concrete inertia and base and housekeeping pad or floor shall be 1".
2. The equipment structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine or isolators.
3. The isolators shall be installed without raising the machine and frame assembly.
4. After the entire installation is complete and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.
5. Install equipment with flexibility in wiring connection.
6. Verify that all installed isolator and mounting systems permit equipment motion in all directions. Adjust or provide additional resilient restraints to flexibly limit start-up equipment lateral motion to ¼".
7. Prior to start-up, clean out all foreign matter between bases and equipment. Verify that there are no isolation short circuits in the base, isolators, or seismic restraints.

3.4 INSPECTION

A. Upon completion of the installation of all vibration isolation and seismic restraints, the manufacturer's local representative shall visit the project jobsite, visibly inspect all installations and report, in writing, any and all deficiencies from the specifications. Any additional corrective measures required to put the system in total compliance shall be the responsibility of the installing Design Builder.

Vibration Isolation and Seismic Restraint Schedule

EQUIPMENT	BASE	ISOLATOR	SEISMIC RESTRAINT	DEFLECTION
ALL DOMESTIC WATER HEATERS			II	
ALL INLINE EXHAUST FANS		E	III	.35
HEAT PUMPS	B-4			
ALL UNIT HEATERS		E	III	.35

END OF SECTION 23 05 48

SECTION 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Identification devices specified in this section include the following:

1. Painted Identification Materials.
2. Plastic Pipe Markers.
3. Plastic Tape.
4. Underground-Type Plastic Line Marker.
5. Plastic Duct Markers.
6. Valve Tags.
7. Valve Schedule Frames.
8. Engraved Plastic-Laminate Signs.
9. Plastic Equipment Markers.
10. Plasticized Tags.

B. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division-15 sections.

C. Refer to other Division-23 sections for identification requirements at central-station mechanical control center; not work of this section.

D. Refer to Division-26 sections for identification requirements of electrical work; not work of this section.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical identification materials:

1. Engineer approved equal.

2.2 MECHANICAL IDENTIFICATION MATERIALS:

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-15 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS:

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/4" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.5 PLASTIC TAPE:

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 UNDERGROUND-TYPE PLASTIC LINE MARKER:

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.

1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.9 ENGRAVED PLASTIC-LAMINATE SIGNS:

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16", except as otherwise indicated.

C. Thickness: 1/8", except as otherwise indicated.

D. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

E. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.10 PLASTIC EQUIPMENT MARKERS:

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:

1. Yellow: Heating equipment and components.
2. Blue: Equipment and components that do not meet any of the above criteria.
3. For hazardous equipment, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and plan number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide approximate 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.11 PLASTICIZED TAGS:

A. General: Manufacturer's standard pre-printed or partially pre- printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre- printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.12 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
   1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS:

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION:

A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacings along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

3.3 MECHANICAL EQUIPMENT IDENTIFICATION:

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gages, thermometers and similar units.
3 Fans, blowers, primary balancing dampers.
4 trainers, filters and similar equipment.

B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).

1. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

3.4 ADJUSTING AND CLEANING:

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.5 EXTRA STOCK:

A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION 23 05 53

SECTION 23 05 93 – TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this section.

1.2 SUMMARY:

A. This Section specifies the requirements and procedures total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
B. Test, adjust, and balance the following mechanical systems:

1. Supply/return/outside air systems.
2. Exhaust air systems.
3. Boiler system/radiant floor.
3. Verify temperature control system operation.

1.3 DEFINITIONS:

A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:

1. the balance of air distribution;
2. adjustment of total system to provide design quantities;
3. electrical measurement;
4. verification of performance of all equipment and automatic controls;
5. sound and vibration measurement.

B. Test: To determine quantitative performance of equipment.

C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

F. Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

G. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

1.4 SUBMITTALS:

A. Agency Data:

1. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

B. Engineer and Technicians Data:

1. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.

D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Section 230500.

E. Sample Forms: Submit sample forms, if other than those standard forms prepared by the NEBB are proposed.

F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

1. Draft reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.

3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
   a. General Information and Summary
   b. Air Systems
   c. Temperature Control Systems
4. Report Contents: Provide the following minimum information, forms and data:
   a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.
   b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC and NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

G. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.5 QUALITY ASSURANCE:

A. Agency Qualifications:

1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives.Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB as a Test and Balance Engineer.

B. Codes and Standards:

1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

2. ASHRAE: ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.

1.6 PROJECT CONDITIONS:

A. Systems Operation: Systems shall be fully operational prior to beginning procedures. Verify with engineer prior to commencing of testing.

1.7 SEQUENCING AND SCHEDULING:

A. Test, adjust and balance hydronic systems at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING:

A. Before operating the system, perform these steps:

1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
2. Obtain copies of approved shop drawings of hydronic system layout, outlets (supply and return) and temperature control diagrams.
3. Compare design to installed equipment and field installations.
4. Prepare schematic diagrams of system "as-built" to facilitate reporting.

3.2 MEASUREMENTS:

A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

B. Provide instruments meeting the specifications of the referenced standards.

C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

D. Apply instrument as recommended by the manufacturer.

E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.

G. Take all reading with the eye at the level of the indicated value to prevent parallax.

H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

I. Take measurements in the system where best suited to the task.

3.3 PERFORMING TESTING, ADJUSTING, AND BALANCING:

A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

B. Cut insulation and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

C. Patch insulation and housings, using materials identical to those removed.

D. Seal piping, and test for and repair leaks.

E. Seal insulation to re-establish integrity of the vapor barrier.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.4 RECORD AND REPORT DATA:

A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.

B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.5 DEMONSTRATION:

A. Training:

1. Train the Owner's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Review with the Owner's personnel, the information contained in the Operating and Maintenance Data specified in Section 230500.
2. Schedule training with Owner through the Architect/Engineer with at least 7 days prior notice.

END OF SECTION 23 05 93

SECTION 23 07 00 – DUCT INSULATION

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.

B. Division-23 sections, apply to work of this section..

1.2 DESCRIPTION OF WORK

A. Extent of mechanical insulation required by this section is indicated by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. HVAC Duct Systems Insulation:
   a. Fiberglass.

C. Refer to Division-23 section "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields; not work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

B. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Ownes Corning
2. Johns Manville
3. Knauf

2.2 DUCTWORK INSULATION MATERIALS:

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1.

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, Class B-4.

C. Jackets for Ductwork Insulation: ASTM C 921, Type I.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

F. Provide R-value and thickness shall be provide as required per most current IECC standards.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF HVAC DUCT INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose. All proposed ductwork shall be insulated.

B. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

C. Clean and dry duct surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier jackets on duct insulation, and protect to prevent puncture or other damage.

E. Extend duct insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

3.3 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 07 00

SECTION 23 31 00 – HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes rectangular and round ducts.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

2.2 FIRE-STOPPING

A. Refer to Division 7 Section "Firestopping" for fire-stopping.

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.

B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.

1. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1985 Edition, for sheet steel width and gage and steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.4 RECTANGULAR DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

2.5 RECTANGULAR DUCT FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1985 Edition, Figures 2-1 through 2-10.

2.6 ROUND DUCT FABRICATION

A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct.

B. Round Ducts: Fabricate round supply ducts with spiral lockseam construction to elbows being pleated. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Install ducts with the fewest possible joints.

B. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

C. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

D. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.

E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or in soffits.

3.2 HANGING AND SUPPORTING

A. Install rigid round, and rectangular metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.

B. Support horizontal ducts within 2 feet of each elbow.

C. Support vertical ducts at each floor.

D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.

E. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.3 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors.

B. Clean ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 23 31 00

SECTION 23 31 13 – METAL DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes rectangular and round ducts.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA Standards:
   1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

2.2 FIRE-STOPPING

A. Refer to Division 7 Section "Firestopping" for fire-stopping.

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.

B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
   1. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1985 Edition, for sheet steel width and gage and steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.4 RECTANGULAR DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.
   1. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

2.5 RECTANGULAR DUCT FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1985 Edition, Figures 2-1 through 2-10.

2.6 ROUND DUCT FABRICATION

A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct.

B. Round Ducts: Fabricate round supply ducts with spiral lockseam construction to elbows being pleated. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Install ducts with the fewest possible joints.

B. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

C. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

D. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.

E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or in soffits.

3.2 HANGING AND SUPPORTING

A. Install rigid round, and rectangular metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.

B. Support horizontal ducts within 2 feet of each elbow.

C. Support vertical ducts at each floor.

D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.

E. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.3 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Duct Accessories."

B. Clean ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 23 31 13

SECTION 23 33 00 – DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Types of ductwork accessories required for project include the following:

1. Dampers.
   a. Low pressure manual dampers.
   b. Control dampers.
   c. Counterbalanced relief dampers.
2. Fire and smoke dampers.
3. Turning vanes.
4. Duct hardware.
5. Duct access doors.
6. Flexible connections.

B. Refer to other Division-23 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.3 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. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 DAMPERS:

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

B. Control Dampers: Provide dampers with parallel blades for 2- position control, or opposed blades for modulating control. Construct blades of 16-ga steel, provide heavy-duty molded self-lubricating nylon bearings, 1/2" diameter steel axles spaced on 9" centers. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1-1/4" x 16-ga channel for face areas over 25 sq. ft. Provide galvanized steel finish with aluminum touch-up.

C. Control Dampers: Refer to Division-23 section "Control Systems" for control dampers; not work of this section.

D. Counterbalanced Relief Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to relieve at indicated static pressure. Construct blades of 16-ga aluminum, provide 1/2" diameter ball bearings, 1/2" diameter steel axles spaced on 9" centers. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1-1/4" x 16-ga channel for face areas over 25 sq. ft. Provide galvanized steel finish on frame with aluminum touch-up.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering dampers which may be incorporated in the work include, but are not limited to, the following:

1. Air Balance, Inc.
2. Airguide Corp.
3. American Warming & Ventilating, Inc.
4. Arrow Louver and Damper; Div. of Arrow United Industries, Inc. Louvers & Dampers, Inc.
5. Penn Ventilator Co.
6. Ruskin Mfg. Co.

2.2 FIRE AND SMOKE DAMPERS:

A. Fabricated Fire Dampers: Provide dampers constructed in accordance with SMACNA "Fire Dampers and Heat Stop Guide".

B. Fire Dampers: Provide fire dampers, of types and sizes indicated. Construct casings of 11-ga galvanized steel with bonded red acrylic enamel finish. Provide fusible link rated at 160 to 165 degrees F (71 to 74 degrees C) unless otherwise indicated. Provide damper with positive lock in

closed position, and with the following additional features:

1. Damper Blade Assembly: Single-blade type.
2. Damper Blade Assembly: Multi-blade type.
3. Damper Blade Assembly: Curtain type.
4. Blade Material: Steel, match casing.
5. Blade Material: Stainless steel.

C. Fire/Smoke Dampers: Provide fire/smoke dampers, of types and sizes indicated. Construct casings of 11-ga galvanized steel with bonded red acrylic enamel finish. Provide fusible link rated at 160 to 165 degrees F (71 to 74 degrees C) unless otherwise indicated. Provide additional frangible link containing explosive charge, connected in series with fusible link. Provide stainless steel spring loaded leakage seals in sides of casing, and 36" long wire leads for connecting smoke link to smoke detector, and the following additional features:

1. Damper Blade Assembly: Single-blade type.
2. Damper Blade Assembly: Multi-blade type.
3. Damper Blade Assembly: Curtain type.
4. Blade Material: Steel, matching casing.
5. Blade Material: Stainless steel.

D. Motor-Driven Fire/Smoke Dampers: Provide motor-driven fire/smoke dampers in types and sizes indicated, with casing constructed of 11-ga galvanized steel with bonded red acrylic enamel finish, fusible link 160 to 165 degrees F (71 to 74 degrees C), unless otherwise indicated, and curtain type stainless steel interlocking blades, with electric motor equipped with instant closure clutch, stainless steel cable damper blade linkage, motor mounting bracket, and 32" long wire leads for connecting to smoke detector, and with the following construction features:

1. Unit Assembly: Motor mounted outside air stream.
2. Unit Assembly: Motor mounted inside air stream.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire and smoke dampers which may be incorporated in the work include, but are not limited to, the following:

1. Air Balance, Inc.
2. American Warming & Ventilating, Inc.
3. Arrow Louver and Damper; Div. of Arrow United Industries Inc.
4. Louvers and Dampers, Inc.
5. Penn Ventilator Co.
6. Phillips-Aire
7. Ruskin Mfg. Co.

2.3 TURNING VANES:

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

B. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" o.c., supported with bars perpendicular to blades set at 2" o.c., and set into side strips suitable for mounting in ductwork.

C. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusion with perforated faces and fiberglass fill.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering turning vanes which may be incorporated in the work include, but are not limited to, the following:

1. Aero Dyne Co.
2. Airsan Corp.
3. Anemostat Products Div.; Dynamics Corp. of America.
4. Barber-Colman Co.
5. Duro Dyne Corp.
6. Environmental Elements Corp.; Subs, Koppers Co., Inc.
7. Hart & Cooley Mfg. Co.
8. Register & Grille Mfg. Co., Inc.
9. Souther, Inc.

2.4 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 for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct hardware which may be incorporated in the work include, but are not limited to, the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.

2.5 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. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct access doors which may be incorporated in the work include, limited to the following:

1. Air Balance Inc.
2. Ruskin Mfg. Co.
3. Ventifabrics, Inc.
4. Zurn Industries, Inc.; Air Systems Div.

2.6 FLEXIBLE CONNECTORS:

A. General: Provide flexible duct connections wherever ductwork connects to 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 vibration of connected equipment.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering flexible connections which may be incorporated in the work include, limited to the following:

1. American/Elgen Co.; Energy Div.
2. Flexaust (The) Co.
3. Ventfabrics, Inc.

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. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is to small for person to enter.

D. 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.

1. Label access doors in accordance with Division-23 section "Mechanical Identification".
2. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing".

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 EXTRA STOCK:

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 23 33 00

SECTION 23 37 00 – AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Types of outlets and inlets required for project include the following:

1. Ceiling air diffusers.
2. Wall registers and grilles.
3. Louvers.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and

spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS: (See schedule for additional requirements)

A. Materials: Aluminum Construction, diffusers shall be constructed entirely on extruded aluminum.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule.

1. Diffuser Faces:
   a. Round: Round housing, core of concentric rings, round duct connection.
   b. Half-Round: Semi-circular housing, core of concentric half-rings, rectangular duct connection.
   c. Square: Square housing, core of square concentric louvers, square or round duct connection.
   d. Rectangular: Rectangular housing, core of rectangular concentric louvers, square or round duct connection.
   e. Panel: Square or rectangular housing extended to form a panel to fit in ceiling system module, core of square or rectangular concentric louvers, square or round duct connection.
   f. Perforated: Round, square, or rectangular housing covered with removable perforated panel in frame. Conceal air pattern devices above panel.
   g. Linear: Extruded aluminum continuous slot, single or multiple.

2. Diffuser Mountings: AS REQUIRED
   a. Stepped-Down: Diffuser housing below ceiling with perimeter flange and gasket to

seal against ceiling construction.

b. Flush: Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.
c. Lay-In : Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.
d. Snap-In: Diffuser housing sized to fit between ceiling concealed suspension runners, and snap into runners.

3. Diffuser Patterns: AS REQUIRED
   a. Fixed: Fixed position core with concentric rings or louvers for radial air flow around entire perimeter of diffuser.
   b. 2 Position: Manual 2-position core with concentric rings or louvers, upper position for horizontal air flow, lower position for vertical air flow.
   c. Adjustable: Manual adjustable core with concentric rings or louvers, fully adjustable for horizontal to vertical air flow.
   d. Supply and Return: 2-section core, center position for return, perimeter for supply.
   e. 1 Way: Fixed louver face for 1-direction air flow, direction indicated on drawings.
   f. 2 Way: Fixed louver face for 2-direction air flow, directions indicated on drawings.
   g. 3 Way: Fixed louver face for 3-direction air flow, directions indicated on drawings.
   h. 4 Way: Fixed louver face for 4-direction air flow, directions indicated on drawings.
   i. Induction: Internal aspirator designed to mix air drawn into center core with conditioned air.
   j. Rearrangeable Core: Modular directional core which can be rearranged for selected air pattern.

4. Diffuser Dampers:
   a. Opposed Blade: Adjustable opposed blade damper assembly, key operated from face of diffuser.
   b. Butterfly: Two semicircular flaps connected to linkage adjustable from face of diffuser with key, and with straightening grid.
   c. Supply and Return: For supply and return diffusers, butterfly type damper in return neck, annular adjustable dampers in supply duct.
   d. Integral: Combination volume control and pattern adjustment for linear diffusers.
   e. Fire Damper: Combination adjustable opposed blade damper and fusable link fire damper with UL approved link and assembly designed to meet requirements of NFPA 90A.

5. Diffuser Accessories:
   a. Equalizing Deflectors: Adjustable parallel blades in frame for straightening air flow.
   b. Smudge Ring: Extension perimeter frame around diffuser, sized so induced air impinges on frame and not on ceiling.
   c. Plaster Ring: Perimeter ring designed to act as a plaster stop and diffuser anchor.
   d. Extractor: Curved blades mounted on adjustable frame to produce air scooping action in duct at diffuser take-off.
   e. Blank-Off Baffles: Arc segments designed to fit into diffuser housing to divert air flow from impinging on obstruction.

   f. Operating Keys: Tools designed to fit through diffuser face and operate volume control device and/or pattern adjustment.

6. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work limited to the following:

    1. Krueger
    2. Price
    3. Titus Products Div.; Philips Industries, Inc.

2.2 WALL REGISTERS AND GRILLES:

A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.

D. Types: Provide wall registers and grilles of type, capacity, and with accessories and finishes.
    1. Register and Grille Materials:
        a. Aluminum Construction: Manufacturer's standard extruded aluminum frame and adjustable blades.

    2. Register and Grille Faces: AS REQUIRED
        a. Horizontal Straight Blades: Horizontal blades, individually adjustable, at manufacturer's standard spacing.
        b. Vertically Straight Blades: Vertical blades, individually adjustable, at manufacturer's standard spacing.
        c. Horizontal 45 Degree Fixed Blades: Horizontal blades, fixed at 45 degrees, at manufacturer's standard spacing.

    3. Register and Grille Patterns:
        a. Single Deflection: 1-set of blades in face.
        b. Double Deflection: 2-sets of blades in face, rear set at 90 degrees to face set.

    4. Register and Grille Dampers:
        a. Opposed Blade: Adjustable opposed blade damper assembly, key operated from face of register
        b. Opposed Blade Fusible Link: Opposed blade damper with spring closing and UL-listed fusible link for 160 degrees F (71 degrees C).

    5. Register and Grille Accessories:
        a. Extractor: Curved blades mounted on adjustable frame to produce air scooping action in duct at register or grille take-off.
        b. Plaster Frame: Perimeter frame designed to act as plaster stop and register or grille

anchor.

c. Operating Keys: Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustable.

2.3 LOUVERS:

A. General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.

C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.

E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

2.4 LINEAR DIFFUSERS

A. Type: Supply Registers shall be adjustable double-deflection type extruded aluminum.

B. Bars: Provide vertical adjustable face bars and horizontal adjustable rear bars spaces ¾ inch on centers.

C. Fins: In lieu of rear bars, fixed horizontal fins, removable as a unit from the register face, and providing three position up-down adjustment may be furnished.

D. Frames: Provide extruded frames fitted with felt, neoprene or plastic gaskets.

E. Dampers: Provide register dampers of formed steel, cadmium plated, gang key operated, opposed blade type and arranged so that the operating mechanism shall not project through any part of the register face.

F. Mounting hardware: Provide round or countersunk head Phillips screws.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.3 SPARE PARTS:

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 23 37 00

SECTION 23 82 24 – POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of power ventilators:

1. Ceiling-mounted ventilators.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for selected models, including specialties, accessories, and the following:
   a. Certified fan performance curves with system operating conditions indicated.
   b. Certified fan sound power ratings.
   c. Motor ratings and electrical characteristics plus motor and fan accessories.
   d. Materials gages and finishes, including color charts.
   e. Dampers, including housings, linkages, and operators.

2. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
3. Coordination drawings, in accordance with Division 23 Section "Basic Mechanical Requirements," for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:
   a. Roof framing and support members relative to duct penetrations.
   b. Ceiling suspension members.
   c. Method of attaching hangers to building structure.
   d. Size and location of initial access modules for acoustical tile.
   e. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
4. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field- installed wiring.
5. Product certificates, signed by manufacturers of air-handling units, certifying that their products comply with specified requirements.
6. Maintenance data for air-handling units, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23 Section "Basic Mechanical Requirements."

1.3 QUALITY ASSURANCE

A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and

components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Lift and support units with the manufacturer's designated lifting or supporting points.

B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations specified in Division 7.

B. Coordinate the size and location of structural steel support members.

1.6 EXTRA MATERIALS

A. Furnish one additional complete set of belts for each belt-driven fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to, the following:

1. Ceiling-Mounted Ventilators:
   a. Greenheck Fan Corp.
   b. Cook (Loren) Co.
   c. Nutone.

2.2 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required:

1 Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

2 Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

2.3 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor: 1.4.

D. Belts: Oil-resistant, nonsparking, and nonstatic.

E. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.

1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.

F. Shaft Bearings: Provide type indicated, having a median life "Rating Life" (AFBMA (L(50)) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

G. Factory Finish: The following finishes are required:

1. Sheet Metal Parts: Prime coating prior to final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.5 CEILING-MOUNTED VENTILATORS

A. General Description: Centrifugal fan designed for installation in ceiling, wall, or concealed inline applications.

B. Housing: Galvanized steel lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Stainless steel, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Remote Fan Speed Control: Solid state, capable of controlling fan speed from full speed to approximately half speed.

G. Accessories: Manufacturer's standard roof jack, wall cap, and transition fittings as required.

2.6 MOTORS

A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

B. Motor Sizes: Minimum sizes and electrical characteristics as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.

C. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).

D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B. Provide permanent-split capacitor classification motors for shaft-mounted fans and capacitor start classification for belted fans.

1. Bases: Adjustable.
2. Bearings: The following features are required:
   a. Ball or roller bearings with inner and outer shaft seals.
   b. Grease lubricated.
   c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

3. Enclosure Type: The following features are required:
   a. Open drip-proof motors where satisfactorily housed or remotely located during operation.
   b. Guarded drip-proof motors where exposed to contact by employees or building occupants.

4. Overload protection: Built-in, automatic reset, thermal overload protection.
5. Noise rating: Quiet.
6. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112, Test Method B.
7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

F. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, roof curbs, equipment supports, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated. Vibration control devices are specified in Division 23 Section "Vibration Controls."

1. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.

3.3 CONNECTIONS

A. Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections.

B. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in Division 26.
2. Temperature control wiring and interlock wiring are specified in Division 23 Section "Electrical Control Systems."
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

3.5 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.6 COMMISSIONING

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
   1. Remove shipping blocking and bracing.
   2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
   3. Perform cleaning and adjusting specified in this Section.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
   5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
   6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
   7. Disable automatic temperature control operators.

B. Starting procedures for fans:
   1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
   2. Measure and record motor electrical values for voltage and amperage.
      a. Replace fan and motor pulleys as required to achieve design conditions.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

3.7 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:

   1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
   2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout" and Division 23 Section "Basic Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION 23 82 24

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

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 this and the other sections of Division 26.

1.2 SUMMARY

A. This Section includes general administrative, procedural, and other requirements for electrical installations. The following requirements are included in this Section to expand the requirements specified in Divisions 1 through 26:
   1. Submittals.
   2. Quality control.
   3. Definitions and abbreviations.
   4. Scheduling.
   5. Coordination drawings.
   6. Record documents.
   7. Maintenance manuals.
   8. Delivery, storage, and handling.
   9. Products.
   10. Rough-ins.
   11. Electrical installations.
   12. Permits and instructions.
   13. Field quality control.
   14. Protection.
   15. Additional work.
   16. Electrical schedules.
   17. Cutting and patching.

1.3 SUBMITTALS

A. General: Follow the procedures specified in Division 1.

B. Increase, by the quantity listed below, the number of electrical related shop drawings, product data, and samples submitted, to allow for required distribution plus two copies of each submittal required, which will be retained by the Electrical Consulting Engineer.
   1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line prints.
   2. Shop Drawings - Final Submittal: 1 additional blue- or black-line prints.
   3. Product Data: 1 additional copy of each item.
   4. Samples: 1 addition as set.

C. Additional copies may be required by individual sections of these Specifications.

1.4 QUALITY CONTROL

A. Functional and Operational Test Procedure:
   1. Test procedure to completely test all systems as to their functional and sequential operation.
   2. Submit two (2) draft copies for review before conducting test.

3. Certify that the test procedure was used and testing completed, and that all systems are operational and functioning properly.
4. Submit certified Test Procedure for review prior to the date of final inspection.
5. Systems to be covered by test procedure:
   a. Fire Alarm Systems
   b. Call-For-Assistance Systems
   c. Optional Standby Generators
   d. Lighting

B. Other Tests and Certifications for:
   1. Grounding System: As specified under Section 260526.

1.5 DEFINITIONS AND ABBREVIATIONS

A. Electrical Definitions: As defined by NEC, Article 100.

B. The term "indicated" shall mean "as shown on contract documents (specifications, drawings, and related attachments)".

C. The term "provide" shall mean "to furnish, install and connect completely".

D. The term "size" shall mean one or more of the following: "length, current and voltage rating, number of poles, NEMA size, and other similar electrical characteristics".

E. The term "space" on panelboard and switchboard schedules shall mean "provide space to install the number of poles and size of the protective device indicated with all the necessary buss and fittings to install the device at some future date".

1.6 SCHEDULING

A. Coordinate electrical work with other divisions of this project.

B. Coordinate electrical work with Owner.

C. Written requests for approval for planned shutdowns or interruption of Owner's operation or equipment shall be made 72 hours prior to the start of the requested periods.

D. Written notification for on site training of Owner's personnel shall be made 1 week prior to the start of the requested training period.

1.7 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with Division 1 to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
   1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:

a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
b. Fire-rated wall and floor penetrations.
c. Equipment connections and support details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, raceway systems components, Exhaust/Kitchen hoods, and other ceiling-mounted devices.

1.8 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, indicate installed conditions for:
1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.9 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1. In addition to the requirements specified in Division 1, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. As specified under other RELATED SECTIONS.

B. As specified on Drawings.

2.2 MATERIAL

A. General:

1. Unless otherwise indicated, all raceways for service, feeders, branch and control wiring are RSC or IMC. See Section 260533.
2. Unless otherwise indicated, wiring to equipment and motors shall be installed in liquid tight flexible conduit, or in interior locations in flexible metal conduit, with a maximum length of six (6) feet.
3. Unless otherwise indicated, all conductors to be copper THHN/THWN-2.
4. Unless otherwise indicated, all outlet and switch boxes to be cast iron with threaded hubs.
5. In interior protected locations, where recessed in ceiling and walls, outlet and switch boxes may be stamped steel.
6. Unless otherwise indicated, provide heavy duty grade, 20 ampere, receptacles and switches. Provide associated cover plates. Plates for surface mounted interior boxes in unfinished areas shall be stamped steel. Plates exposed to weather or water to be metal, weatherproof type. Receptacles, switches and associated cover plates color by Architect/Owner.

B. As specified under RELATED SECTIONS.

C. As specified on Drawings.

2.3 EQUIPMENT

A. General:

1. Unless otherwise indicated, externally operated safety switches are unfused, solid neutral, heavy duty, and selected to meet the load requirements.

B. As specified under RELATED SECTIONS.

C. As specified on Drawings.

2.4 FABRICATION

A. General:

1. Unless otherwise indicated, all enclosures are NEMA Type 1. NEMA Type 3R shall be used for all wet/damp locations.

B. As specified under RELATED SECTIONS.

C. As specified on Drawings.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 26 for rough-in requirements.

C. Contractor is to provide connections, both power and control as noted, for HVAC equipment. Division 26 shall coordinate the respective installations with other project disciplines.

3.2 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other building components. Electrical plans and details do not show all interferences and conditions, visible and/or hidden, that may exist. Before selecting material and equipment, and proceeding with work, inspect areas where material and equipment are to be installed to insure suitability, and check needed space for placements, clearances and interconnections. Before cutting or drilling into building elements inspect and layout work to avoid damaging structural elements or building utilities.
2. Electrical plans, details, and diagrams show the general location and arrangement of electrical systems. They are diagrammatic and do not show all conduit bodies, connectors, bends, fittings, hangers, and additional pull and junction boxes which the Contractor must provide to complete the electrical system.
3. Verify all dimensions by field measurements.
4. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
5. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
6. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building. Verify dimensional constraints of building door openings and passageways, and the maximum floor loadings, for the movement of selected material and equipment. Order equipment and material, broken down as may be required, to meet these constraints.
7. Measurement from above finished floor (AFF) shall be taken from the finished floor surface to the top of wall receptacles and switch boxes, to the centerline of wall lighting outlet boxes, to the top of wall mounted equipment enclosures, to the centerline of top most switch handle, or to the lowest surface of ceiling lighting fixtures and other ceiling mounted equipment.
   a. Unless otherwise indicated, wall switch boxes shall be 46 inches AFF.
   b. Unless otherwise indicated, receptacle boxes shall be 18 inches AFF. Receptacle mounted above counter and at furniture locations shall be coordinated with architectural elements. Coordinate with Architect.
   c. Surface raceway heights shall be coordinated with Architectural requirements.
8. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible. Switch and receptacle heights shall meet handicap accessible code requirements.
9. Coordinate connection of electrical systems with incoming utilities and services. Comply with requirements of governing regulations, power, telephone, and data service companies, and controlling agencies. Provide required connection for each service. Provide power connection to equipment. Coordinate with other Divisions.

10. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
11. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
12. Conduit Sizing:
    a. Unless otherwise indicated, conduit size for indicated conductor shall be based on Chapter 9 of NEC.
    b. Conduit: 1/2 inch minimum size.

13. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Measure and locate placement of equipment and materials in relation to building structure and surfaces, and between equipment to be installed and wired. Maintain required minimum access spacing for equipment and enclosures.
14. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified elsewhere.
15. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
16. Unless otherwise noted, individual raceway runs are required for each kitchen equipment component. Connection shall be routed down existing walls exposed, concealed in new walls, and/or under slab to the respective area as noted.

3.3 PERMITS AND INSPECTIONS

A. Obtain and pay for all required permits and arrange for all required inspections in accordance with state and local governing authorities.

B. Final Electrical Inspection Certificate from inspection agency or governing authority.

3.4 FIELD QUALITY CONTROL

A. Perform field tests as specified under other electrical sections.

B. Arrange for local Inspection Authorities to inspect work performed prior to burial, closing-in behind wall and above ceiling, or encased in concrete. Also arrange for final inspection of work and obtain Final Inspection Certificate before final inspection of work by Owner or his representative.

3.5 PROTECTION

A. Protect personnel from coming in contact with live parts.

B. During remodeling or alteration work, maintain fire ratings of walls, floors and ceilings when work is left unattended.

C. Protect from damage and theft equipment and materials provided or supplied by others in accordance with manufacturer's recommendation and warranties, and with electrical standards and practices.

3.6 ADDITIONAL WORK

A. Provide temporary electric service power outlets and lighting during construction.

B. Provide connections for power and controls to mechanical equipment being supplied under other divisions.

C. Provide power and control wiring to HVAC equipment.

3.7 ELECTRICAL SCHEDULES

A. As specified in related sections or shown on drawings.

3.8 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 1. In addition to the requirements specified in Division 1, the following requirements apply:
   1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
      a. Uncover Work to provide for installation of ill-timed Work.
      b. Remove and replace defective Work.
      c. Remove and replace Work not conforming to requirements of the Contract Documents.
      d. Remove samples of installed Work as specified for testing.
      e. Install equipment and materials in existing structures.
      f. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.

   2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
   3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
   4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
   5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
   6. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
   7. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION 26 05 00

SECTION 26 05 01 – COMMON WORK RESULTS FOR ELECTRICAL MATERIALS AND METHODS

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 this Section.

B. Requirements specified in other Division 26 Sections apply to this section.

1.2 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:
   1. Miscellaneous metals for support of electrical materials and equipment.
   2. Fire rated wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment.
   3. Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
   4. Access panels and doors in walls, ceilings, and floors for access to electrical materials and equipment.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for the following products:
   1. Access panels and doors.
   2. Joint sealers.

C. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for electrical materials and equipment.

D. Coordination drawings for access panel and door locations in accordance with Division 26 Section "Common Work Results for Electrical."

E. Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.

F. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.

G. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut off of electrical service, and details for dust and noise control.

1. Coordinate sequencing with construction phasing and Owner occupancy as specified in other Divisions.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer for the installation and application of joint sealers, access panels, and doors.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code Steel."
1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Fire Resistance Ratings: Where a fire resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
1. Provide UL Label on each fire rated access door.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi component materials.

B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

1.6 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:
1. Protect adjacent materials indicated to remain or in the other phases of the proposed construction. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
2. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
3. Arrange for electric service change-overs during periods when the building is not occupied. This may include week-ends and evening hours. Coordinate with Owner's representatives.

B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do no apply joint sealers to wet substrates.

1.7 SEQUENCE AND SCHEDULING

A. Coordinate the shut off and disconnection of electrical power with the Owner.

B. Notify the Engineer at least 5 days prior to commencing demolition operations.

C. Perform demolition in sequencing/phases as noted and as required.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold Formed Steel Tubing: ASTM A 500.

C. Hot Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Nonshrink, Nonmetallic Grout: Premixed, factory packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.

F. Fasteners: Zinc coated, type, grade, and class as required.

2.2 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light framing size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP 2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less that 3/4 inches.

2.3 JOINT SEALER

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One part, nonacid curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
2. One part, mildew resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in service exposure to conditions of high humidity and temperature extremes.
3. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
   a. One Part, Nonacid Curing, Silicone Sealant:
      1) Bostik - "Chem Caulk 2000"

2) Dow Corning - "Dow Corning 790"
3) Pecora Corp – “864NST”

b. One Part, Mildew Resistant, Silicone Sealant:
1) Dow Corning - "Dow Corning 786"
2) GE - "SCS 1702”
3) Pecora Corp. - "898”

D. Acrylic Emulsion Sealants: One part, nonsag, mildew resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
a. Bostik - "Chem Caulk 600"
b. Pecora Corp. - "AC 20"
c. Tremco – “Tremflex 834”

E. Fire Resistant Joint Sealers: Two part, foamed in place, silicone sealant formulated for use in through penetration fire stopping around cables, conduit, pipes, and duct penetrations through fire rated walls and floors. Sealants and accessories shall have fire resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
a. Dow Corning - "Dow Corning Fire Stop Foam"
b. GE - "Pensil 851"
c. Hilti – “CP-620 Fire Stop Foam”

2.4 ACCESS DOORS
A. Steel Access Doors and Frames: Factory fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16 gage steel, with a 1 inch wide exposed perimeter flange for units installed in unit masonry, pre cast, or cast in place concrete, ceramic tile, or wood paneling.
1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch wide exposed perimeter flange and adjustable metal masonry anchors.
2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
3. For full bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

C. Flush Panel Doors: 14 gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory applied prime paint.
1. Fire Rated Units: Insulated flush panel doors, with continuous piano hinge and self closing mechanism.

D. Locking Devices: Flush, screwdriver operated cam locks.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:
   1. Bar Co., Inc.
   2. J.L. Industries.
   3. Karp Associates, Inc.
   4. Milcor Div. Inryco, Inc.
   5. Nystrom, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION FOR JOINT SEALER

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

D. Do not install wood materials in areas being utilized as air plenum or other spaces where a potential combustible hazard exists.

3.5 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
   1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
   2. Comply with recommendations of ASTM C 790 for use of acrylic emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

C. Installation of Fire Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.6 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

END OF SECTION 26 05 01

SECTION 26 05 19 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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 this Section.

B. Requirements of other specified Division 26 Sections apply to this section.

1.2 SUMMARY

A. This Section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts and less.

1.3 SUBMITTALS

A. Product Data for electrical wires, cables and connectors.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following code:

B. NFPA 70 "National Electrical Code."
   1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

C. UL Compliance: Provide components which are listed and labeled by UL under the following standards.
   1. UL Std. 83 Thermoplastic-Insulated Wires and Cables.
   2. UL Std. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
   3. UL Std. 1569 Metal Clad Cable.

D. NEMA/ICEA Compliance: Provide components which comply with the following standards:
   1. WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

E. IEEE Compliance: Provide components which comply with the following standard.
   1. Std. 82 Test procedures for Impulse Voltage Tests on Insulated Conductors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
   1. Wire and Cable:
      a. American Insulated Wire Corp.
      b. Republic Wire Inc.
      c. Southwire Company.
   2. Connectors for Wires and Cable Conductors:

a. AMP
b. 3M Company

c. O-Z/Gedney Co.
d. Square D Company.

2.2 WIRES AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.

B. Conductors: Provide stranded conductors for power and lighting circuits no. 10 AWG and smaller. Provide stranded conductors for sizes no. 8 AWG and larger.

C. Conductor Material: Copper for all wires and cables.

D. Conductor sizes indicated are based on copper.

E. Insulation: Provide THHN/THWN-2 insulation for all conductors size 500MCM and larger, and no. 8 AWG and smaller. For all other sizes provide, THHN/THWN-2 or XHHW insulation as appropriate for the locations where installed.

F. Color Coding for phase identification in accordance with Table 1 in Part 3 below.

G. Jackets: Factory-applied nylon or PVC external jacketed wires and cables for pulls in raceways over 100-feet in length, for pulls in raceways with more than three equivalent 90 deg. bends, for pulls in conduits underground or under slabs on grade, and where indicated.

H. Cables: Provide the following type(s) of cables in NEC approved locations and applications where indicated. Provide cable UL listed for particular application:
1. Metal-Clad Cable: Type MC - limited to the following:
a. Lighting fixtures and outlets concealed in gypsum wallboard partitions.

2.3 CONNECTORS FOR CONDUCTORS

A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Use the following wiring methods as indicated:
1. Wire: install all wire in raceway.
2. Metal Clad Cable, Type MC: where wiring concealed in gypsum wall partitions and ceilings, for connections from raceway outlet boxes to lighting fixtures, unless otherwise noted.

3.2 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Coordinate cable installation with other Work.

C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

E. Conceal all cable in finished spaces.

F. Keep conductor splices to minimum.

G. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.

H. Use splice and tap connectors which are compatible with conductor material.

I. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than no 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

J. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.

B. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

D. TABLE 1: Color Coding for Phase Identification:

1. Color code secondary service, feeder, and branch circuit conductors with factory applied color as follows:

208Y/120Volts	Phase	120/240Volts
Black	A	Black
Red	B	Red

Blue	C	-
White	Neutral	White
Green	Ground	Green

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 26 Section "low voltage electrical power conductors and cables."

1.2 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for ground rods, connectors and connection materials, and grounding fittings.

C. Field-testing organization certificate, signed by the Contractor, certifying that the organization performing field tests complies with the requirements specified in Quality Assurance below.

D. Report of field tests and observations certified by the testing organization.

1.3 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
1. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Field-Testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

C. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code" (NEC).

D. UL Standard: Comply with UL 467, "Grounding and Bonding Equipment."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Anixter Bros., Inc.
2. Bashlin Industries, Inc.

3. Buckingham Mfg. Co.
4. Erico Products, Inc.
5. GB Electrical, Inc.
6. Ideal Industries, Inc.
7. O-Z/Gedney Co.
8. Raco, Inc.
9. Thomas & Betts Corp.

2.2 GROUNDING AND BONDING PRODUCTS

A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

B. Conductor Materials: Copper.

2.3 WIRE AND CABLE CONDUCTORS

A. General: Comply with Division 26 Section "low voltage electrical power conductors and cables." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

B. Equipment Grounding Conductor: Green insulated.

C. Grounding Electrode Conductor: Stranded cable.

D. Bare Copper Conductors: Conform to the following:
1. Assembly of Stranded Conductors: ASTM B-8.

2.4 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section.

B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.

C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.5 CONNECTOR PRODUCTS

A. General: Listed and labeled as grounding connectors for the materials used.

B. Pressure Connectors: High-conductivity-plated units.

C. Bolted Clamps: Heavy-duty units listed for the application.

D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

E. Aluminum-To-Copper Connections: Bimetallic type, conforming to UL 96, "Lighting Protection Components," or UL 467.

2.6 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
   1. Size: 5/8 inch by 8 feet.

B. Plate Electrodes: Copper plates, minimum 0.10 inch thick, size as required per N.E.C. indicated.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
   1. Install separate insulated equipment grounding conductors with circuit conductors for the following in addition to those locations where required by Code:
      a. Lighting circuits.
      b. Feeders and branch circuits.
      c. Receptacle Circuits.
      d. Single-phase motor or appliance circuits.
      e. Three-phase motor or appliance branch circuits.

3.2 INSTALLATION

A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.

B. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.

C. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

D. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

3.3 CONNECTIONS

A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. 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 assure high conductivity and make contact points closer in order of galvanic series.
   2. Make connections with clean bare metal at points of contact.
   3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
   4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

B. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

C. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

D. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

E. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

3.4 FIELD QUALITY CONTROL

A. Independent Testing Organization: Arrange and pay for the services of a qualified independent electrical testing organization to perform tests described below.

B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."

C. Ground/resistance maximum values shall be as follows:
1. Equipment rated 500 kVA and less: 5 Ohms
2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms
3. Equipment rated over 1000 kVA: 3 Ohms
4. Pad Mounted equipment: 5 ohms.

D. Deficiencies: Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated the provisions of the Contract, covering changes will apply.

E. Report: Prepare test reports, certified by the testing organization, of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

END OF SECTION 26 05 26

SECTION 26 05 29 – SUPPORTING DEVICES

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 this Section.

B. Requirements specified in other Division 26 Sections apply to this section.

1.2 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of product specified.
   1. Hanger and support schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.

C. Shop drawings indicating details of fabricated products and materials.

D. Engineered Design consisting of details and engineering analysis for supports for the following items:
   1. Fastener supporting systems.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third party certification follow up services.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. Slotted Metal Angle and U Channel Systems:
      a. Allied Tube & Conduit
      b. B Line Systems, Inc.
      c. GS Metals Corp.
      d. Unistrut Diversified Products

   2. Conduit Sealing Bushings:

a. Bridgeport Fittings, Inc.
b. Cooper Industries, Inc.
c. O Z/Gedney
d. Producto Electric Corp.
e. Raco, Inc.
f. Spring City Electrical Mgf. Co.
g. Thomas & Betts Corp.

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:
1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.

C. Conduit Sealing Bushings: Factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. Cable Supports for Vertical Conduit: Factory fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable iron casting with hot dip galvanized finish.

E. U Channel Systems: 16 gage steel channels, with 9/16 inch diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U channel and are of the same manufacture.

2.4 FABRICATED SUPPORTING DEVICES

A. General: Shop or field fabricated supports or manufactured supports assembled from U channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves of one of the following:
1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
a. 3 inch and smaller: 20 gage.
b. 4 inch to 6 inch: 16 gage.

c. over 6 inch: 14 gage.

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Raceway Supports: Comply with the NEC and the following requirements:
1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze type hangers.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
6. Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with NEC.
7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

D. Vertical Conductor Supports: Install simultaneously with installation of conductors.

E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

F. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on

opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

G. Sleeves: Install in concrete slabs and walls and all other fire rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply UL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with requirements specified elsewhere.

H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
   1. Fasten by means of wood screws or screw type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
   2. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
   3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration and shock resistant fasteners for attachments to concrete slabs.

J. TESTS: Test pull out resistance of one of each type, size, and anchorage material for the following fastener types:
   1. Expansion anchors.
   2. Toggle bolts.

K. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

L. Conduit seals at walk-in cooler& freezer location: Install seals for conduit penetrations into cooler or freezer equipment where conduit enters the repsective conditional areas, and at slab locations.

3.2 TABLE I: SPACING FOR RACEWAY SUPPORTS

HORIZONTAL RUNS

Raceway Size (Inches)	No. of Conductors in Run (1)	Location	RMC & IMC (1)	EMT
1/2,3/4	1 or 2	Flat ceiling or wall.	5	5
1/2,3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7
1/2,3/4	3 or more	Any location.	7	7
1/2 1	3 or more	Any location.		
1 & larger	1 or 2	Flat ceiling or wall.	6	6
1 & larger	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10
1 & larger	3 or more	Any location.	10	10
Any	....	Concealed.	10	10

VERTICAL RUNS

Raceway Size (Inches)	No. of Conductors in Run	Location	RMC & IMC (1,2)	EMT (1)
1/2,3/4	....	Exposed.	7	7
1,1 1/4	....	Exposed.	8	8
1 1/2 and larger	....	Exposed.	10	10
Up to 2	....	Shaftway.	14	10
2 1/2	....	Shaftway.	16	10
3 & larger	....	Shaftway.	20	10
Any	....	Concealed.	10	10

NOTES:
(1) Maximum spacing of supports (feet).
(2) Maximum spacings for IMC above apply to straight runs only. Otherwise the maximums for EMT apply.

Abbreviations:

EMT Electrical metallic tubing.
IMC Intermediate metallic conduit.
RMC Rigid metallic conduit.

END OF SECTION 26 05 29

SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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 this Section.

B. Requirements specified in other Division 26 Sections apply to this section.

1.2 SUMMARY

A. This Section includes raceways for electrical wiring. Types of raceways in this section include the following:
   1. Rigid metal conduit.
   2. Intermediate metal conduit.
   3. Liquidtight flexible conduit.
   4. Flexible metal conduit.
   5. Electrical Metallic Tubing (EMT).
   6. Rigid nonmetallic conduit.
   7. Wireways.

B. This section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this Section include:
   1. Outlet and device boxes.
   2. Pull and junction boxes.
   3. Cabinets.
   4. Hinged door enclosures.

C. Related Sections: The following Division 26 Sections contain requirements that relate to this Section:
   1. "Low voltage electrical power conductors and cables" for other wiring methods.
   2. "Supporting Devices" for raceway supports.

1.3 DEFINITIONS

A. Cabinets: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.

B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.

C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.

D. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.

E. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or of switches for controlling electrical circuits.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:
   1. Product data for Raceway systems.
   2. Product data for cabinets and enclosures with classification higher than NEMA 1.
   3. Shop drawings for boxes, enclosures and cabinets that are to be shop fabricated, (nonstock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.

1.5 QUALITY ASSURANCE

A. UL Listing and Labeling: Items provided under this section shall be listed and labeled by UL.

B. Nationally Recognized Testing Laboratory Listing and Labeling (NRTL): Items provided under this section shall be listed and labeled by a NRTL. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

C. National Electrical Code Compliance: Components and installation shall comply with NFPA 70 "National Electrical Code."

D. NEMA Compliance: Comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

E. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

F. Provide raceway products and components listed and labeled by UL, ETL, or CSA.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with other Work, including metal and concrete deck installation, as necessary to interface installation of electrical raceways and components with other Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

B. Conduit Bodies:
   1. Appleton Electric Co.
   2. Carlon
   3. Killark Electric Mfg. Co.
   4. O Z/Gedney
   5. Spring City Electrical Mfg. Co.

C. Wireways:

1. Erickson Electric Equipment Co.
2. GS Metals Corp.
3. Hoffman Engineering Co.

D. Cabinets:
1. Erickson Electrical Equipment Co.
2. Hoffman Engineering Co.
3. Spring City Electrical Mfg. Co.
4. Square D Co.

2.2 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. Intermediate Steel Conduit: UL 1242.

C. Electrical Metallic Tubing and Fittings: ANSI C80.3

D. Flexible Metal Conduit: UL 1, zinc coated steel.

E. Liquid-tight Flexible Metal Conduit and Fittings: UL 360. Fittings shall be specifically approved for use with this raceway.

2.3 NONMETALLIC CONDUIT AND DUCTS

A. Rigid Nonmetallic Conduit: NEMA TC 2 and UL 651, Schedule 40 or 80 PVC.

B. PVC Conduit and Tube Fittings: TC 3; match to conduit or conduit/tube type and material.

C. Conduit, Tubing and Duct Accessories: Types, sizes and materials complying with manufacturer's published product information. Mate and match to raceway.

2.4 CONDUIT BODIES

A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion resistant screws.

B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.

C. Conduit Bodies 1 Inch and Smaller: Use bodies with compression type threaded connectors.

D. Nonmetallic Conduit and Tubing: Use nonmetallic conduit bodies conforming to UL 514B

2.5 WIREWAYS

A. General: Electrical wireways shall be of types, sizes, and number of channels indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapeters, hold-down straps, and end caps shall match and mate with wireway as required for completed system. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC.

B. Wireway covers to be hinged type.

2.6 CABINETS, BOXES, AND FITTINGS, GENERAL

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations. This applies to kitchen areas.

B. Materials and finish
1. Sheet Steel: Flat rolled, code gage, galvanized steel.
2. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.
3. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.
4. Cast Metal for Boxes, Enclosures, and Covers; Copper free aluminum except as otherwise specified.
5. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.
6. Painted Interior Finish: Where indicated, white baked enamel.
7. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connecters.

2.7 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application.

B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

C. Cast Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

2.8 PULL OR JUNCTION BOXES

A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.

C. Hot Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot dip galvanized after fabrication. Cover shall be gasketed.

D. Stainless Steel Boxes: Fabricate of stainless steel conforming to Type 302 of ASTM A 167, "Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip." Where necessary to provide a rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.

E. Cast Iron Boxes: Molded of cast iron alloy with gasketed cover and integral threaded conduit entrances.

2.9 CABINETS

A. Comply with UL 50, "Electrical Cabinets and Boxes."

B. Construction: Sheet steel, NEMA 4 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately 3/4 inch larger than the box all around. For surface mounted cabinets make front same height and width as box.

C. Doors: Double doors for cabinets wider than 24 inches.

D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

2.10 STEEL ENCLOSURES WITH HINGED DOORS

A. Comply with UL 50, "Cabinets and Enclosures" and NEMA ICS 6,

B. "Enclosures for Industrial Controls and Systems."

C. Construction: Sheet steel, 16 gage, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.

D. Doors: Hinged directly to cabinet and removable, with approximately 3/4 inch flange around all edges, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24 inches. Provide multiple doors where required.

E. Mounting Panel: Provide painted removable internal mounting panel for component installation.

F. Enclosure: NEMA 4 except as indicated. Where door gasketing is required, provide neoprene gasket attached with oil resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use hubbed raceway entrances.

PART 3 – EXECUTION

3.1 RACEWAY WIRING METHOD

A. Outdoors: Use the following wiring methods:
   1. Exposed / Concealed: Rigid metal conduit, Intermediate metal conduit.
   2. Underground: Rigid metal conduit, Rigid nonmetallic conduit.
   3. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic, or electric solenoid or motor driven equipment: liquidtight flexible metal conduit. Maximum length 6 feet.

B. Indoors: Use the following wiring methods:
   1. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic or electric solenoid or motor operated equipment: Flexible metal conduit. Maximum length 6 feet.
   2. Exposed/Concealed: branch circuits: EMT.
   3. Exposed/Concealed Panelboards feeders: Intermediate metal conduit, Rigid metal conduit.
   4. Connection to vibrating equipment and hydraulic, pneumatic, or electric solenoid or motor driven equipment in moist or humid location or corrosive atmosphere, or where subject to water spray or dripping oil, grease, or water: Liquidtight flexible metal conduit. Maximun length 6 feet.

3.2 RACEWAY INSTALLATION

A. General: Install electrical raceways in accordance with manufacturer's written installation instructions, applicable requirements of NEC, and as follows:

B. Conceal Conduit, unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and hot water pipes. Install raceways level and square and at proper elevations.

C. Elevation of Raceway: Where possible, install horizontal raceway runs above water and sanitary piping.

D. Complete installation of electrical raceways before starting installation of conductors within raceways.

E. Provide supports for raceways as specified elsewhere in Division 26.

F. Prevent foreign matter from entering raceways by using temporary closure protection.

G. Protect stub ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

H. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

I. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.

J. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.

K. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.

L. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases provide field bends for parallel raceways.

M. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.

N. Tighten set screws of threadless fittings with suitable tool.

O. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.

P. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

Q. Install pull wires in empty raceways. Use no. 14 AWG zinc coated steel or monofilament plastic line having not less than 200 lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

R. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
   1. Where conduits pass from warm locations to cold locations, such as the boundaries of conditioned spaces and mechanical spaces.
   2. Where required by the NEC.

S. Stub up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the

finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor.

T. Flexible Connections: Use short length (maximum of 6 ft.) of flexible conduit for recessed and semirecessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet locations. Install separate ground conductor across flexible connections. Light fixture flexible connections shall not exceed 15 ft.

3.3 CABINETS AND BOXES INSTALLATION, GENERAL

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Support and fasten items securely in accordance with Division 16 Section "Supporting Devices."

D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

E. Remove sharp edges where they may come in contact with wiring or personnel.

3.4 APPLICATIONS

A. Cabinets: Flush mounted, NEMA enclosure Type 1 except as otherwise indicated.

B. Hinged Door Enclosures: NEMA Type 1 enclosure except as indicated.

C. Hinged Door Enclosures Outdoors: Install drip hood, factory tailored to individual units.

D. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:
   1. Interior Dry Locations: NEMA Type 1, sheet steel or as permitted by local code.
   2. Locations Exposed to Weather, Dampness, or Wet Locations: NEMA Type 3R enclosures.

E. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.

3.5 INSTALLATION OF OUTLET BOXES

A. Outlets at Windows and Doors: Locate close to window trim.

B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.

C. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood

walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.

D. Gasketed Boxes: At the following locations use cast metal, threaded hub type boxes with gasketed weatherproof covers:
   1. Exterior locations.
   2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations).
   3. Where exposed to moisture laden atmosphere.
   4. Where indicated.

E. Cast Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

F. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles either vertically or horizontally but consistently either way. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side.

G. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4 inches square by 1 1/2 inches deep, minimum.

H. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

I. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

3.6 INSTALLATION OF PULL OR JUNCTION BOXES

A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 inches square by 4 inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the following:

Size of Largest Conductors in Box	Maximum no. of Conductors in Box
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

1. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.
2. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
3. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.7 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

A. Mount with fronts straight and plumb.

B. Install with tops 78 inches above floor.

C. Set cabinets in finished spaces flush with walls.

3.8 GROUNDING

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

3.9 RACEWAY ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

3.10 CLEANING AND FINISH REPAIR

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using a zinc rich paint recommended by the tray manufacturer.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch up coating.

END OF SECTION 26 05 33

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

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 this Section.

B. Requirements specified in other Division 26 Sections apply to this section.

1.2 SUMMARY

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:
   1. Identification labeling for switchboards, panelboards, devices, raceways, cables, and conductors.
   2. Operational instruction signs.
   3. Warning and caution signs.
   4. Equipment labels and signs.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 26 Section “Low voltage electrical power conductors and cables." for requirements for color coding of conductors for phase identification.

C. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Schedule of identification nomenclature to be used for identification signs and labels.

D. Samples of each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

B. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. American Labelmark Co.
   2. Ideal Industries, Inc.
   3. LEM Products, Inc.
   4. Markal Corp.
   5. National Band and Tag Co.
   6. Panduit Corp.
   7. Seton Name Plate Co.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

A. Adhesive Marking Labels for Raceway and Cable: Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Lighting, Power, Light, Air Conditioning, Communications, Control, Fire, etc.).

B. Label Size: as follows:
   1. Raceways 1-Inch and Smaller: 1-1/8 inches high by 4 inches long.
   2. Raceways Larger than 1-Inch: 1-1/8 inches high by 8 inches long.

C. Color: Black legend on orange background.

D. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

E. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Raceway and Cable Identification: Flexible acrylic bands sized to suit the raceway diameter and arranged to stay in place by pre- tensioned gripping action when coiled around the raceway or cable.

F. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self- adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

G. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends to suit the application. Orange background, except as otherwise indicated, with Eyelet for fastener.

H. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners.

I. Baked-Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

J. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gage, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.

K. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

L. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color coding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Conduit Identification:
1. The following areas shall be identified:
   a. On wall surfaces directly external to conduits run concealed within wall.
   b. On all accessible surfaces of concrete envelope around conduits in vertical shafts, exposed at ceilings or concealed above suspended ceilings.

2. Apply identification to areas as follows:
   a. Clean surface of dust, loose material, and oily films before painting.
   b. Prime surfaces: For galvanized metal, use single-component acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty acrylic resin block filler. For concrete surfaces, use clear alkali- resistant alkyd binder-type sealer.
   c. Apply one intermediate and one finish coat of orange silicone alkyd enamel.
   d. Apply primer and finish materials in accordance with manufacturer's instructions.

E. Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be pretensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Apply the following colors:
1. Fire Alarm System: Red
2. Fire Suppression Supervisory and Control System: Red
3. Mechanical and Electrical Supervisory System: Green and Blue
4. Telephone System: Green and Yellow

F. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use pressure- sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

G. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

208Y/120 Volts	Phase	120/240Volts
Black	A	Black
Red	B	Red
Blue	C	-
White	Neutral	White
Green	Ground	Green

H. Use conductors with color factory-applied the entire length of the conductors except as follows:
1. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
   a. Apply colored, pressure-sensitive plastic tape in half- lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
   b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

I. Tag or label conductors as follows:
1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
2. Multiple Circuits: Where multiple branch circuits or control wiring or signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and signal wiring, use color coding or wire marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire marking tapes.

3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

J. Apply warning, caution, and instruction signs and stencils as follows:
1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic- laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

K. Install equipment identification as follows:
1. Apply equipment identification labels of engraved plastic- laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.
a. Load centers, electrical cabinets, and enclosures.
b. Access doors and panels for concealed electrical items.

L. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

M. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 26 05 53

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

B. Related Sections: The following Division 16 Sections contain requirements that relate to this Section:
   1. "Overcurrent Protective Devices" for circuit breakers, fusible switches, fuses, and other devices used in panelboards.

1.2 SUMMARY

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

B. Related Sections: The following Division 26 Sections contain requirements that relate to this Section:
   1. "Overcurrent Protective Devices" for circuit breakers, fusible switches, fuses, and other devices used in panelboards.
   2. "Motor Controllers" for combination starters installed in panelboards.

1.3 DEFINITIONS

A. Load Center: A panelboard with thermal magnetic circuit-breaker branches, primarily of the plug-in type, designed for residential and light commercial projects, operating at 240 V and below, available in both single and three-phase versions, and equipped with combination flush/surface mounting trim.

B. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type panelboard, accessory item, and component specified.

C. Shop drawings from manufacturers of panelboards including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:
   1. Enclosure type with details for types other than NEMA Type 1.
   2. Bus configuration and current ratings.
   3. Short-circuit current rating of panelboard.
   4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

D. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field-installed wiring.

E. Qualification data for field-testing organization certificates, signed by the Contractor, certifying that the organization complies with the requirements specified in Quality Assurance below. Include list of completed projects with project names, addresses, and names of Architect and Owner plus basic organization qualifications data.

F. Report of field tests and observations certified by the testing organization.

G. Panel schedules for installation in panelboards. Submit final versions after load balancing.

H. Maintenance data for panelboard components, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 16 Section "Basic Electrical Requirements." Include instructions for testing circuit breakers.

1.5 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
   1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Field-Testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

C. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."

D. NEMA Standard: Comply with NEMA PB1, "Panelboards."

E. UL Standards: Comply with UL 61, "Panelboards," and UL 50, "Cabinets and Boxes."

1.6 EXTRA MATERIALS

A. Keys: Furnish six spares of each type for panelboard cabinet locks.

B. Touch-up Paint for surface-mounted panelboards: One half-pint container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide products from one of the following manufacturers:
   1. Eaton Corp.
   2. General Electric
   3. Siemens

4. Schneider Electric (Square D)

2.2 PANELBOARDS, GENERAL REQUIREMENTS

A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section "Overcurrent Protective Devices," with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.

B. Enclosures: Cabinets, flush or surface mounted as indicted. NEMA Type 1 enclosure, except where the following enclosure requirements are indicated.
1. NEMA 3R: Raintight.

C. Front: Hinged front covers.

D. Directory Frame: Metal, mounted inside each panel door.

E. Bus: Hard drawn copper of 98 percent conductivity.

F. Main and Neutral Lugs: Compression type.

G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

H. Service Equipment Approval: Listed for use as service equipment for panelboards having main service disconnect.

I. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

J. Special Features: Provide the following features for panelboards as indicated.
1. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
2. Hinged Front Cover: Entire front trim hinged to box with standard door within hinged trim cover.
3. Split Bus: Vertical bus of indicated panels divided into two vertical sections with connections as indicated.
4. Skirt For Surface-Mounted Panels: Same gage and finish as panel front with flanges for attachment to panel, wall, and floor.
5. Extra Gutter Space: Dimensions and arrangement as indicated.
6. Gutter Barrier: Arranged to isolate section of gutter as indicated.
7. Column-Type Panelboard Configuration: Narrow cabinet extended as wireway to overhead junction box equipped with ground and neutral terminal buses.
8. Subfeed: OCPD or lug provision as indicated.

K. Feed-Through Lugs: Sized to accommodate feeders indicated.

2.3 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Double-Width Panels: Where more than 42 poles are indicated or where otherwise indicated, provide two panelboards under single front.

C. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

2.4 LOAD CENTERS

A. Provide load-center-type panelboards in dwelling units only.
   1. General: Conform to above article "Panelboards, General Requirements" except as follows:

B. OCPDs: Plug-in full module (nominal 1-inch width) circuit breaker.

C. Circuit Breakers for Switching Lights at Panelboards: Indicated type SWD.

D. Circuit Breakers for Equipment Marked HACR Type: Indicated HCAR type.

E. Interiors: Provide physical means to prevent installation of more OCPDs than the quantity for which the enclosure was listed.

F. Main, Neutral, and Ground Lugs and Buses: Have mechanical connectors for conductors.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.

C. Spare Fuse Cabinet: Identified, compartmented, lockable steel box or cabinet with compartments suitable for surface mounting on wall.

2.6 IDENTIFICATION

A. Panelboard Nameplates: Engraved laminated plastic or metal nameplate for each panelboard mounted with epoxy or industrial cement or industrial adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.

B. Mounting Heights: Top of trim 6'-2" above finished floor, except as indicated, or required to fit existing wall cavity.

C. Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.

D. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.

E. Install filler plates in unused spaces.

F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future. Stub four 1-inch empty conduits into raised floor space or below slab other than slabs on grade.

G. Auxiliary Gutter: Install where a panel is tapped to a riser at an intermediate location.

H. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

3.2 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs in accordance with Division 16 Section "Electrical Identification."

3.3 GROUNDING

A. Connections: Make equipment grounding connections for panelboards as indicated.

B. Provide ground continuity to main electrical ground bus indicated.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization in to perform tests on low-voltage power panelboards and accessories.

B. Pretesting: Upon completing installation of the system, perform the following preparations for independent tests:

1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.
2. Make continuity tests of circuits.
3. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.

C. Quality Control Program: Conform to the following:

1. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.

2. Schedule tests with at least one week in advance notification.
3. Reports by Testing Organization: Report written reports of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.
4. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person, and date.
5. Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.

D. Visual and Mechanical Inspection: Include the following inspections and related work:
1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
5. Perform visual and mechanical inspection and related work for overcurrent protective devices as specified in Division 16 Section "Overcurrent Protective Devices."

E. Electrical tests: Include the following items performed in accordance with manufacturer's instruction:
1. Insulation resistance test of buses and portions of control wiring that disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.
2. Ground resistance test on system and equipment ground connections.
3. Test main and subfeed overcurrent protective devices in accordance with Section "Overcurrent Protective Devices."

F. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards by testing organization. Verify by the system tests that the total assembly meets specified requirements.

3.6 CLEANING
A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.7 COMMISSIONING
A. Balancing Loads: After Substantial Completion, but not more than two months after Final Acceptance, conduct load-balancing measurements and circuit changes as follows:
1. Perform measurements during period of normal working load as advised by the Owner.
2. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as FAX machines and on-line data processing, computing, transmitting, and receiving equipment.

3. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

B. Infrared Scanning: After Substantial Completion, but not more than two months after Final Acceptance, perform an infrared scan of each panelboard. Remove fronts to make joints and connections accessible to a portable scanner.

C. Follow-up Infrared Scanning: Perform one additional follow-up infrared scan of each panelboard 11 months after the date of Substantial Completion.

D. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.

E. Record of Infrared Scanning: Prepare a certified report identifying panelboards checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 24 16

SECTION 26 27 26 – WIRING DEVICES

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 this Section.

B. Requirements of the following Division 26 Sections apply to this section:
   1. Common Work Results for Electrical.

1.2 SUMMARY

A. This Section includes the following:
   1. Receptacles
   2. Ground Fault Circuit Interrupter Receptacles
   3. Snap Switches
   4. Wall Plates
   5. Occupancy Sensors
   6. Vacancy Sensors
   7. Lighting Control System
      1. Controller
      2. Occupancy Sensors
      3. Daylight Sensors

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Division 26 Section "Enclosed Switches and Circuit Breakers" for devices other than snap switches and plug/receptacle sets used as disconnects for motors.

1.3 SUBMITTALS

A. Product data for each type of product specified.

B. Samples of those products indicated for sample submission in Architect's comments on product data submittal. Include color and finish samples of device plates and other items per Architect's request.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following codes.

B. NFPA 70 "National Electrical Code".
   1. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

B. Available Manufacturers: Subject to specifications, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
   1. Cooper Wiring Devices
   2. Hubbell Inc.
   3. Leviton
   4. Legrand (Pass and Seymour)

2.2 WIRING DEVICES:

B. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Provide ivory color devices and wall plates except as otherwise indicated. Verify color selections with Architect.

C. Receptacles: As scheduled in Table 1 in Part 3 below. Comply with UL 498 and NEMA WD1.

D. Ground-Fault Circuit Interrupter (GFCI) Receptacles: As indicated in Table 1 in Part 3 below; provide "feed-thru" type ground-fault circuit interrupter, with integral heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2-3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 94.3.

E. Snap Switches: quiet type AC switches as indicated in Table 2 in Part 3 below. Comply with UL 20 and NEMA WD1.

E. Occupancy Sensors (ceiling): Multi-Technology, 360 degree self adjusting ceiling-mounted occupancy sensor. All sensors shall have ready accessible and user adjustable time delay and sensitivity controls. All sensors shall contain manual bypass. 2000 square foot coverage area. Provide appropriate power packs as required for installation.

F. Occupancy Sensors (wall switch): multi-Technology, 180 degree self adjusting wall switch - mounted occupancy sensor. All sensors shall have ready accessible and user adjustable time delay and sensitivity controls. All sensors shall contain manual bypass.

G. Vacancy Sensors (wall switch): multi-Technology, 180 degree self adjusting wall switch - mounted vacancy sensor with manual on – auto off. All sensors shall have ready accessible and user adjustable time delay and sensitivity controls. All sensors shall contain manual bypass.

2.3 WIRING DEVICE ACCESSORIES

A. Wall plates: single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide plates possessing the following additional construction features:
   1. Material and Finish: steel plate, galvanized, for building mechanical spaces.
   2. Material and Finish: plastic, smooth, for tenant spaces, and other finished areas.

2.4 LOW VOLTAGE LIGHTING CONTROL SYSTEM DEVICES

A. Modular, stand-alone one room lighting 0-10V dimming and switching control system with keypad control and room occupancy and daylight sensing for daylight harvesting and energy management.

B. Lighting Controller:
1. Basis of Design: Steinel DCS Controller.
2. Concealed mounting, self contained, multichannel 0-10V lighting controller with occupancy and photo sensor inputs, user-adjustable controls.
3. Mounting: Coordinate in field.

C. Occupancy Sensor:
1. Basis of Design: Steinel IR Quattro.
2. Remote Occupancy Sensors: Combination of ultrasonic motion detection and passive infrared detection with internal microprocessor. Sensor independently adjustable for installed conditions. Delayed time off adjustment. Walk-through mode. Adjustable built-in photocell for daylight optimization.
3. Coverage: 360 deg., 2000 sq. ft..
4. Mounting: Ceiling flush mounted and Ceiling bracket mounted.

D. Photo (Daylight) Sensor:
1. Basis of Design: PS DCS.
2. Photocell Sensor, Open Loop Type: Continually monitors daylight entering window or skylight to enable daylight harvesting applications to provide control of room lighting based on presence of daylight.
3. Mounting: Coordinate in field.

E. Keypads:
1. Basis of Design: Steinel DCS 4-button.
2. Each keypad shall include:
a. A five button key configuration with on, off, up, down. Lighting level shall be preset to 50% dimming level.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements and as required by related sections of Div. 26.

B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.

C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

D. Install galvanized steel wallplates in unfinished spaces.

E. Install wiring devices after wiring work is completed.

F. Install wall plates after painting work is completed.

H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486. Use properly scaled torque indicating hand tool.

3.2 INSTALLATION OF LIGHTING CONTROL SYSTEM:

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements and as required by related sections of Div. 26 and in accordance with the following:
   1. Do not install dimming controls until space is enclosed, HVAC systems are running, and overhead and wet work in dimming control work space are complete.
   2. Grounding: Provide electrical grounding in accordance with NFPA 70.
   3. Perform setup for each lighting system.

B. System Startup:
   1. Provide system startup and adjustment to occupied conditions in accordance with manufacturer's recommendations.
   2. Perform operational testing to verify compliance with Specifications. Adjust as required.
   3. Measure and record load on each controlled circuit in each scene. Submit report of load measurements.

3.3 PROTECTION

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.4 FIELD QUALITY CONTROL

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

B. Test ground fault interruptor operation with both local and remote fault simulations in accordance with manufacturer recommendations.

C. TABLE 1

RECEPTACLES

DESIGNATION (1)	CURRENT RATING AMPS	VOLTAGE RATING	SINGLE/ DUPLEX	NEMA CONFIGURATION	UL GRADE	NOTES
-	20	125	DUPLEX	5-20R	SPECIFICATION GRADE	
GFCI	20	125	DUPLEX	5-20R	SPECIFICATION GRADE	INTEGRAL GFCI
GFCI WP	20	125	DUPLEX	5-20R	SPECIFICATION GRADE	INTEGRAL GFCI WEATHER-PROOF

NOTES
(1) Letter designations are used where symbols alone do not clearly designate on plans locations where specific receptacle types are used.

D. TABLE 2

SNAP SWITCHES

DESIG-NATION (1)	TYPICAL APPLICATION	VOLTAGE LOAD RATING	RATING (AC)	POLES	UL GRADE	NOTES
S	CONTROL LIGHTS	20A	120/277	1	HEAVY DUTY	-
S3	CONTROL LIGHTS	20A	120/277	3-way	HEAVY DUTY	-
S	DISCONN. MOTOR	1HP	120/277	1	HEAVY DUTY	(2)
STOL	DISCONN. MOTOR	2HP	208/480	3	HEAVY DUTY	(2)

NOTES

(1) For snap switches, designation is the same as the symbol used on plans for the device. Type of switch is determined from plan context including type of device or circuit being controlled.
(2) With overload element in switch.

3.6 DEMONSTRATION / TRAINING

A. Demonstration: Schedule dimming controls demonstration with Owner to allow verification that dimming controls function as required.

B. Training: Furnish the services of a factory authorized service representative to instruct Owner's personnel in the operation and maintenance of the lighting control system. Provide a minimum of two (2) two hours sessions of instruction scheduled seven days in advance.

C. All training sessions shall be video recorded. Refer to Division 01 Section 01 79 00 ‘Demostration and Training’ for further requirements.

END OF SECTION 26 27 26

SECTION 26 28 00 – OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes overcurrent protective devices (OCPDs) rated 600 V and below and switching devices commonly used with them.

B. Panelboards: Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment are specified in other Division 16 sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Cartridge Fuses:
   a. Bussmann
   b. Ferraz Shawmut
   c. Littelfuse Inc.

2. Fusible Switches:
   a. Allen-Bradley Co.
   b. Crouse-Hinds Distribution Equipment.
   c. General Electric
   d. Eaton Corp.
   e. Siemens Energy & Automation, Inc.
   f. Schneider Electric (Square D)

3. Molded-Case Circuit Breakers:
   a. Eaton Corp.
   b. General Electric
   c. Siemens Energy & Automation, Inc.
   d. Schneider Electric (Square D)

2.2 OVERCURRENT PROTECTIVE DEVICES (OCPDs), GENERAL

A. General: Provide OCPDs in indicated types, as integral components of panelboards and also as individually enclosed and mounted single units.

B. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, and motor control centers; and also as individually enclosed and mounted single units.

C. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

2.3 CARTRIDGE FUSES

A. General: NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.

B. Class J Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."

C. Class L Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."

D. Class RK1 and RK5 Dual Element Time-Delay Fuses: UL 198E, "Class R Fuses."

E. Class RK1 Fast-Acting Fuses: UL 198E, "Class R Fuses."

2.4 FUSIBLE SWITCHES

A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.

B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.

C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.

D. Operation: By means of external handle.

E. Interlock: Prevents access to switch interior except when in "off" position.

F. Fuse Clips: Rejection type.

G. Padlocking Provisions: For 2 padlocks, whether open or closed.

H. Enclosure for Independent Mounting: NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."

B. Construction: Bolt-in type, except breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

C. Construction: Bolt-in type, except breakers in load-center-type panelboards and breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

D. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating of 10,000 amperes symmetrical, unless a greater rating is indicated.

E. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole.

F. Enclosure for Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.

G. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Independently Mounted OCPDs: Locate as indicated and install in accordance with manufacturer's written installation instructions.

B. OCPDs in distribution equipment shall be factory installed.

3.2 IDENTIFICATION

A. Identify components in accordance with Division 16 Section "Electrical Identification."

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between OCPDs and control/indication devices as specified in Division 16 Section "Wires and Cables" for hard wired connections.

3.4 CONNECTIONS

A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.5 GROUNDING

A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL

A. Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization to perform tests and observations on OCPDs.

B. Reports: Prepare written reports certified by testing organization on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made.

C. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

D. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.

E. Pretesting: Upon completing installation of the system, perform the following preparations for independent tests:
   1. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
   2. Make continuity tests of circuits.
   3. Provide set of Contract Documents to test personnel. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
   4. Provide manufacturer's instructions for installation and testing of OCPDs to test personnel.

F. Visual and mechanical inspection: Include the following inspections and related work.
   1. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.
   2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
   3. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
   4. Check tightness of electrical connections of OCPDs with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
   5. Clean OCPDs using manufacturer's approved methods and materials.
   6. Verify installation of proper fuse types and ratings in fusible OCPDs.

G. Electrical Tests: Include the following items performed in accordance with manufacturer's instructions:
   1. Insulation resistance test of OCPD conducting parts. Insulation resistance less than 100 megohms is not acceptable.
   2. Contact resistance test or measurement of millivolt drop across contacts of drawout circuit breakers and fused power circuit devices at rated current. Compare contact resistance or millivolt drop values of adjacent poles and of similar breakers. Deviations of more than 50 percent are not acceptable.
   3. Insulation resistance test of fused power circuit devices and insulated-case and molded-case circuit breakers over 600-ampere frame size at 1000 V d.c. for one minute from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase. Insulation resistance less than 100 megohms is not acceptable.
   4. Use primary current injection to check performance characteristics of trip units of molded-case breakers over 600-ampere frame size. Trip characteristics not falling within manufacturer's published time-current characteristic tolerance bands when adjusted to approved parameters are not acceptable. Perform the following tests:
      a. Determine minimum pickup current acceptable per manufacturer's instructions.
      b. Determine long-time delay at 300 percent pickup current.
      c. Determine short-time-pickup current and corresponding delay time.
      d. Determine ground-fault current pickup and corresponding delay time.
      e. Determine instantaneous pickup current value.

5. Make adjustments for final settings of adjustable-trip devices.
6. Activate auxiliary protective devices such as ground fault or undervoltage relays, to verify operation of shunt-trip devices.
7. Check operation of electrically operated OCPDs in accordance with manufacturer's instructions.

H. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPDs by testing organization. Verify by the system tests that specified requirements are met.

3.7 CLEANING

A. Upon completion of installation, inspect OCPDs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8 DEMONSTRATION

A. Training: Arrange and pay for the services of factory-authorized service representatives to demonstrate OCPDs and train Owner's maintenance personnel.

B. Conduct a minimum of one half day of training in operation and maintenance as specified under "Instructions to Owner Employees" in the "Project Closeout" Section of these specifications. Include both classroom training and hands-on equipment operation and maintenance procedures.

C. Schedule training with at least seven days' advance notification.

3.9 COMMISSIONING

A. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of OCPDs including their line and load connections, fuses, and fuse clips. Also scan OCPD contact structures where accessible to a portable scanner. Include individual OCPDs and those installed in switchboards, panelboards, and motor control centers.

B. Follow-up Infrared Scanning: Perform two additional follow-up infrared scans of the same devices: one four months after Substantial Completion, and one 11 months after Substantial Completion.

C. Instrument: Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

D. Record of Infrared Scanning: Prepare a certified report identifying all OCPDs checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and rescanning observations after remedial action.

END OF SECTION 26 28 00

SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this Section.

B. Requirements specified in other Division 26 Sections apply to this section.

1.2 SUMMARY

A. This Section includes circuit and motor disconnects.

1.3 SUBMITTALS

A. Product data for each type of product specified.

B. Maintenance data for circuit and motor disconnects, for inclusion in Operation and Maintenance Manual specified in Division 1 and Division 16 Section "Basic Electrical Requirements."

1.4 QUALITY ASSURANCE

A. Electrical Component Standards: Provide components complying with NFPA 70 "National Electrical Code" and which are listed and labeled by UL. Comply with UL Standard 98 and NEMA Standard KS 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
   1. Appleton
   2. Crouse-Hinds Co.
   3. Eaton Corp.
   4. Schneider Electric (Square D)

2.2 CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features ratings, and enclosures as indicated. Provide NEMA 1 enclosure except for outdoor switches, and other indicated locations provide NEMA 3R enclosures with raintight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.

B. Fusible Switches: Heavy duty switches, with fuses of classes and current ratings indicated. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses.

C. Non-fusible Disconnects: Heavy duty switches of classes and current ratings as indicated.

D. Double-Throw Switches: Heavy duty switches of classes and current ratings as indicated.

E. Provide weatherproof, NEMA Type 3R rated enclosures at exterior locations.

2.3 ACCESSORIES

A. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches as indicated.

B. Captive Fuse Pullers: Provide built-in fuse pullers arranged to facilitate fuse removal.

PART 3 - EXECUTION

3.1 INSTALLATION OF CIRCUITS AND MOTOR DISCONNECTS

A. General: Provide circuit and motor disconnect switches as indicated and where required by the above Code. Comply with switch manufacturers' printed installation instructions.

3.2 FIELD QUALITY CONTROL

A. Testing: Subsequent to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation, and for verification of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

END OF SECTION 26 28 16

SECTION 26 51 00 - LIGHTING

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 this Section.

1.2 SUMMARY

A. This Section includes egress/exit lighting units, and accessories.

1.3 DEFINITIONS

A. Fixture: A complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps and parts required to distribute the light, position and protect lamps, and connect lamps to the power supply. Internal battery powered exit signs and emergency lighting units also include a battery and the means for controlling and recharging the battery. Emergency lighting units are available with and without integral lamp heads and lamps.

B. Luminaire: Fixture.

C. Average Life: The time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data describing fixtures, lamps, ballasts, and emergency lighting units. Arrange product data for fixtures in order of fixture designation. Include data on features and accessories and the following information:
   1. Outline drawings of fixtures indicating dimensions and principal features.
   2. Electrical ratings and photometric data with specified lamps and certified results of independent laboratory tests.
   3. Data on batteries and chargers of emergency lighting units.

C. Maintenance data for products for inclusion in Operating and Maintenance Manual specified in Division 1.

D. Product certifications signed by manufacturers of lighting fixtures certifying that their fixtures comply with specified requirements.

E. Shop drawings from manufactures detailing nonstandard fixtures and indicating dimensions, weights, methods of field assembly, components, features, and accessories.

F. Coordination drawings for fixtures mounted on, in, or above the ceiling indicating coordination with ceiling grids and other equipment installed in the same space.

G. Samples for verification purposes of specific individual fixtures.

H. Samples for use in full size mockup of specific individual fixtures.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70 "National Electrical Code" for components and installation.

B. Listing and Labeling: Provide fixtures and emergency lighting units that are listed and labeled for their indicated use on the Project.
   1. The terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualification: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. Manufacturers Qualifications: Firms experienced in manufacturing fixtures that are similar to those indicated for this Project and that have a record of successful in-service performance.

D. Coordination of Fixtures With Ceiling: Coordinate fixtures mounting hardware and trim with the ceiling system.

1.6 EXTRA MATERIALS

A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to the Owner.
   1. Lamps: 10 lamps for each 100 of each type and rating installed. Furnish at least 3 of each type.
   2. Plastic Diffusers and Lenses: 1 for each 100 of each type and rating installed. Furnish at least 3 of each type.
   3. Light Fixtures – Five (5) percent of each light fixture type installed. Furnish at least 1 of each type.

PART 2 - PRODUCTS

2.1 FIXTURES, GENERAL

A. Comply with the requirements specified in the Articles below and lighting fixture schedule.

2.2 FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs and sharp corners and edges.

B. Sheet Metal Components: Steel, except as indicated. Components are formed and supported to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating and free from light leakage under operating conditions. Arrange to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position.

D. Reflecting Surfaces: Minimum reflectances as follows, except as 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.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass except as indicated.
1. Plastic: Highly resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
2. Lens Thickness: 0.125 inches, minimum.

2.3 SUSPENDED FIXTURE SUPPORT COMPONENTS
A. Suspended fixtures as indicated in manufacturers installation instructions. See fixture schedule for further requirements.

2.4 INCANDESCENT FIXTURES
A. Conform to UL 1571, "Incandescent Lighting Fixtures."

2.5 LAMPS
A. Conform to ANSI Standards, C78 series applicable to each type of lamp.

2.6 FINISH
A. Steel Parts: Manufacturer's standard finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and defects. Remove fixtures showing evidence of corrosion during project warranty period and replace with new fixtures.

B. Other Parts: Manufacturer's standard finish.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Setting and Securing: Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and approved shop drawings.

B. Support For Recessed and Semi-recessed Fixtures: Installed units are not to be supported from suspended ceiling support system. Install ceiling system support rods or wires at a minimum of four rods or wires per fixture located not more than 6 inches from fixture corners.
1. Fixtures Smaller Than Ceiling Grid: Install a minimum of four rods or wires for each fixture and locate at corner of the ceiling grid where the fixture is located. Do not support fixtures by ceiling acoustical panels.
2. Fixtures of Sizes Less Than Ceiling Grid: Center in the acoustical panel. Support fixtures independently with at least two 3/4-inch metal channels spanning and secured to the ceiling tees.
3. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corners.

C. Support for Suspended Fixtures: Brace pendants and rods that are 4-feet long or longer to limit swinging. Support stem mounted single-unit suspended fluorescent fixtures with

twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.

D. Lamping: Lamp units according to manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Give advance notice of dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source.

E. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.3 ADJUSTING AND CLEANING

A. Clean fixtures upon completion of installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 26 51 00