INSTRUCTIONS FOR:

Happiness Bag
New Facilities

3833 Union Road
Terre Haute, Indiana 47802

HOLDERDESIGN
ARCHITECTURE • GRAPHICS • CONSULTING

24 South 5th Street
Terre Haute, Indiana 47807
phone: 812.235.1300
www.holderdesign.net

SET NUMBER_____

INDEX

HOLDERDESIGN
ARCHITECTURE • GRAPHICS • CONSULTING

24 South 5th Street
Terre Haute, Indiana 47807
phone: 812.235.1300
www.holderdesign.net

August 12, 2024

INSTRUCTIONS TO BIDDERS

PROJECT:		Happiness Bag – New Facilities 3833 Union Road Terre Haute, Indiana 47802
OWNER:		Happiness Bag Players Inc. 3833 Union Road Terre Haute, Indiana 47802
CONTACT:		Ms. Jodi Moan, Executive Director
CONSTRUCTION MANAGER:		Earl C. Rogers and Associates Inc. P.O. Box 205 West Terre Haute, Indiana 47802
CONTACT:		Mr. Michael Shaw m@ecrogers.com 812.533.2161
BIDS:	Due by:	Friday, September 27, 2024 at 2:30 pm
	At Offices:	Sealed bids are to be turned in at Happiness Bag any time prior to 2:30 pm on Friday, September 27, 2024
	Bid on attached	Bid Form
	Bid Bond	None
	Performance Bond	None
	Payment Bond	None
	Mark Envelope	"Happiness Bag – New Facilities"
	Start Date	As soon as Owner awards Contract.
	Bids to be good for	60 days from date which bid are due.
	Contract	Contract to be prepared by the Owner.

DOCUMENTS:

Architect/Engineering Drawings
Instructions to Bidders with attached scopes of work
Drawings and specifications shall be available as directed by the Owner.

CONTRACTORS RESPONSIBILITY:

A. Direct all questions to the Architect and Construction Manager via email.
B. Contractor shall visit the site and familiarize themself with the work. We will conduct a non-mandatory walkthrough at the site at 1:00 pm on September 11, 2024.
C. The Contractor shall leave the site in as clean condition as before the construction.
D. mechanical, Electrical and Plumbing Contractor shall obtain Local permits and include cost in the bid. CM will obtain General Trades permit.
E. State approvals will be obtained by Architect, where required.
F. The Contractor shall coordinate with the CM when work is to begin.
G. The Owner is Not subject to Indiana Sales Tax and such tax should Not be Included in the bids.
H. If the Contractors discover any discrepancies on the drawings or in the specifications, they shall report the same to the Architect before proceeding with any work affected by the discrepancy, and shall be held responsible for the results should they fail to make such report.

GENERAL CONDITIONS:

A. The drawings are for reference only. The Contractors shall verify all existing site conditions.
B. The Owner is to have access to the site at all times.
C. The Contractors shall clean surroundings on a daily basis.
D. The staging of materials shall be approved by the CM.
E. Any sidewalks damaged during construction shall be replaced by the Contractor at no charge to the Owner.

MAINTENANCE:

A. The Contractors shall maintain the grounds and adjacent spaces within the project.
B. The Contractors shall protect all existing walls, glass, and existing buildings. Damaged areas are to be brought back to original condition.

DEMOLITION:

A. The Contractors are to remove and dispose of all debris in a legal manner. The Cm will provide dumpsters
B. The Contractors shall maintain dust control at all times.
C. Remove all existing construction shown on the drawings.
D. Remove all materials associated with the demolition work from the site.

SCOPE OF WORK: (ADDITIONAL ITEMS MAY APPLY)

A. Maintain safety barricades. If and as required.
B. Remove existing construction as necessary and as stated on the drawings in order to install the new work under this contract.

1. Subcontractors and all lower-tier subcontractors shall be bound by, and at their own cost shall comply with, all federal, state and local laws, codes, ordinances and regulations including but not limited to federal income and employment tax, workers' compensation, licensing, safety, wage payment, and unemployment contribution obligations.

2. The Contractor is aware of the instability to production and the harm to the construction industry caused by non-compliance with local, state, and federal safety, employment, and tax laws. The Contractor is also aware that so-called labor subcontractors or providers frequently violate such laws. Accordingly, the Subcontractor and any lower-tier contractors shall avoid contracting with any such labor subcontractors or providers to perform work on the construction site.

3. Prior to the commencement of work, the Subcontractor shall disclose to the Contractor the names, business addresses, phone numbers, and primary contact person for each Subcontractor or lower-tier subcontractor known at that time. After commencement of work, such information shall be provided to the Contractor by the last day of each month. The Contractor shall provide that information to state, federal or local law enforcement agencies upon request.

4. The Contractor shall be provided with current workers' compensation insurance certificates by the Subcontractor and any lower-tier subcontractors before they perform work on the construction site. The Contractor shall be notified of any cancellation or revocation of workers' compensation coverage. Upon request, the Contractor shall provide such certificates to any state, federal, or local law enforcement agencies.

5. In connection with the performance of work under this contract, the Subcontractor and all lower-tier subcontractors agree not to discriminate against any employee or applicant for employment because of race, religion, sex, or national origin. The obligation includes, but is not limited to, the following: employment, upgrading, demotion, or transfer; recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

6. A violation of the terms of this Article shall be a material breach and can subject the Subcontractor or lower tier subcontractor to adverse consequences including but not limited to termination of contract and/or the withholding of retainage or payment. The Subcontractor and lower-tier subcontractors, either jointly or severally, shall be liable to the Contractor for all losses, costs, fines, penalties, or corrective measures and expenses resulting from a failure to comply with this Article attributable to any acts of commission or omission by any of them, their employees, or agents.

7. Written contracts are required for all Subcontractors or lower-tier subcontractors. The Subcontractor shall place the terms of this Article in all contracts with its Subcontractors or lower-tier subcontractors and shall require them to place it in all of their contracts with Subcontractors or lower-tier subcontractors. Copies of all such contracts will be provided to the Contractor within thirty (30) days of execution.

CORONAVIRUS STATE AND LOCAL FISCAL RECOVERY FUNDS (CSLFRF) (ALN #21.027)

GRANT AGREEMENT

This Grant Agreement (the "Grant Agreement"), entered into by and between the **Vigo County Commissioners/City of Terre Haute** and **Happiness Bag Players, Inc. dba Happiness Bag, Inc.** (the "Grantee"), is executed pursuant to the terms and conditions set forth herein. In consideration of those mutual undertakings and covenants, the parties agree as follows:

1. Purpose of this Grant Agreement; Funding Source.

The Grant must be used exclusively per the provisions of this Grant Agreement. The Grant received by the Grantee under this Grant Agreement shall be used only to implement or fund a Project in conformance with this Grant Agreement and for no other purpose.

2. Representations and Warranties of the Grantee.

A. The Grantee expressly represents and warrants to the Vigo County Commissioners/City of Terre Haute that it is eligible to receive Grant funds and that the information set forth in its Plan is true, complete, and accurate. The Grantee expressly agrees to promptly repay all funds paid to it under this Grant Agreement if the Vigo County Commissioners/City of Terre Haute determines that Grantee was ineligible to receive the funds, made any misrepresentation on its Plan, or used funds for any purpose inconsistent with this Grant Agreement.

B. The Grantee represents, as is applicable, that it is currently in compliance with and will remain in compliance with the registration and reporting requirements of 2 C.F.R. Part 25 and 2 C.F.R. Part 170.

3. Grant Funding.

A. The Vigo County Commissioners/City of Terre Haute will fund this Grant in the amount of $750,000.00_____.

B. The Vigo County Commissioners/City of Terre Haute will not disburse Grant funds to the Grantee until the Vigo County Commissioners receives and approves all documentary materials required by this Grant Agreement and the Vigo County Commissioners'/City of Terre Haute's compliance partners approve this Grant Agreement, if necessary.

C. The Grantee must comply with the federal statutes and regulations at 2 C.F.R. 200 *et seq.*, the Uniform Administrative Requirement, Cost Principles, and Audit Requirements for Federal Awards, including but not limited to Subparts A-F, as required by the Grant. By submitting a claim under Paragraph 6, the Grantee certifies to the Vigo County Commissioners/City of Terre Haute that all payment claims are allowable, allocable, and reasonable under 2 C.F.R. 200.403 and the other cost principles in Subpart E of Part 200.

4. Term.

A. This Grant Agreement is effective on the day of execution and until the project is complete and the Vigo County Commissioners/City of Terre Haute disburses the final grant amount. Upon the written agreement and as permitted by governing law, the parties may extend the term of this Grant Agreement.

B. The Grantee shall have sixty (60) days following the Expiration Date to submit all final claims for disbursement of Grant funds under this Grant Agreement. Grantee understands that all funds must be committed by December 31, 2024 and expended by December 31, 2026.

C. Any provisions intended to apply after the termination of this Grant Agreement will survive termination until their purposes are fulfilled.

5. Implementation of and Reporting on the Plan.

A. The Grantee is solely responsible for all planning and coordination activities necessary to complete the project. To modify the Project, Grantee must acquire the prior written approval of the Vigo County Commissioners/City of Terre Haute, which may not unreasonably withhold or delay approval.

B. For each project for which the Grantee requests disbursement of funds, the Grantee shall submit to the Vigo County Commissioners/City of Terre Haute a Project Claim Form (the "Claim Form").

(1) The Claim Form, attached herein by reference, will be made available to the Grantee, which is attached herein by reference and subject to reasonable modification over time.

(2) Grantee must complete a separate Claim Form for each project.

(3) Each Claim Form must include:

(a) A detailed description of the project and its alignment with the Plan (if not already a part of the Plan);

(b) All required programmatic data and performance indicators;

(c) A detailed budget including all sources and uses of funding required to implement the project ("Project Budget"); and

(i) After the Vigo County Commissioners/City of Terre Haute approves a Claim Form, the Project Budget funded by this Grant Agreement may not experience a Material Change (as herein defined) without the prior written consent of the Vigo County Commissioners.

(d) The name and contact information for the Grantee, and a certification from the Grantee that it is in compliance with all applicable State and federal laws; and

(e) Any other information or documentation required by the Vigo County Commissioners/City of Terre Haute.

(4) If a project is subject to additional requests for information or documentation from the Vigo County Commissioners/City of Terre Haute, the Grantee may submit Claim Forms for projects not initially included in the Plan as an additional project of the Plan. If the Vigo County Commissioners/City of Terre Haute approves a Claim Form for a Project not initially included in the Plan, the project automatically becomes part of the Grantee's Plan.

(5) The Vigo County Commissioners/City of Terre Haute will have thirty (30) days to evaluate a submitted Claim Form and provide notice of its decision to approve or deny the Claim Form. If additional time is needed to evaluate a submitted Claim Form, the Vigo County Commissioners/City of Terre Haute must notify the Grantee of a date by which its decision can be expected. The Vigo County Commissioners/City of Terre Haute agrees that it will not unreasonably extend any such review.

(6) The Grantee understands and agrees that the Vigo County Commissioners/City of Terre Haute retains the right to approve or deny a Claim Form, as determined by the Vigo County Commissioners/City of Terre Haute under this Grant Agreement.

(7) The Vigo County Commissioners/City of Terre Haute may condition its approval of a submitted Claim Form as it deems appropriate. The Grantee may accept, reject, request a further revision to the conditional approval, or submit an amended Claim Form. A conditionally approved Claim Form is approved only if the Grantee gives written notice of its acceptance of the Claim Form and provides documentation of its satisfaction with the Vigo County Commissioners'/City of Terre Haute's conditions.

(8) The Vigo County Commissioners/City of Terre Haute may request from the Grantee any additional information or written documentation relating to a Project necessary for the Vigo County Commissioners/City of Terre Haute to perform its obligations under this Grant Agreement. The Grantee must use its best efforts to obtain these

materials and provide them to the Vigo County Commissioners/City of Terre Haute within a reasonable time.

(9) After the Vigo County Commissioners/City of Terre Haute approves a Claim Form, the Grantee must provide notice to the Vigo County Commissioners/City of Terre Haute of any Material Changes to a Project. A "Material Change" occurs when there is any:

(a) Increase in the total cost of a project of five percent (5%) or more and would require additional Grant funds for the project as a result of that increase;

(b) Change of a project from the Grantee's submission on the approved Claim Form, including a change in how the Grant funds will be used for an approved project.

(10) Within ten (10) business days after receipt of a notice of Material Change, the Vigo County Commissioners/City of Terre Haute will notify the Grantee if an amended Claim Form is required to proceed with the project.

(11) If there is a Material Change requiring an amended Claim Form, the Vigo County Commissioners/City of Terre Haute may approve or deny the amended Claim Form.

(12) The Grantee may enter into any contracts or agreements necessary or incidental to the performance of this Grant Agreement; however, the Vigo County Commissioners/City of Terre Haute is not bound by any contracts or agreements of the Grantee's unless agreed by the Vigo County Commissioners/City of Terre Haute in writing.

(13) After the Grantee submits a Claim Form, the Grantee must submit to the Vigo County Commissioners/City of Terre Haute written progress reports until the completion of the project. The Grantee must submit these reports monthly, not later than the seventh (7th) day of the month following the month subject to the report. The report must contain such detail of progress or performance on the Plan and any Projects funded through this Grant Agreement as is requested by the Vigo County Commissioners/City of Terre Haute.

6. Payment of Claims.

A. If governing law permits advance payment of the Grant funds and the Vigo County Commissioners/City of Terre Haute agrees to provide it, the Vigo County Commissioners/City of Terre Haute will only advance payment upon submission of a Payment Request Form. A Payment Request Form is attached to this Agreement. After Grantee expends advance funds, Grantee must provide the Vigo County Commissioners/City of Terre Haute with a reconciliation of those expenditures. The Vigo County Commissioners/City of Terre Haute will

review all requests for projects performed directly by the Grantee. The Vigo County Commissioners/City of Terre Haute will disburse Grant funds within thirty-five (35) days of compliance partners' approval.

B. As required by IC § 4-13-2-14.8, all payments will be by direct deposit by electronic funds transfer to the financial institution designated by the Grantee in writing unless a specific waiver has been obtained.

C. Payment requests will be processed only upon presentation of a Payment Request Form. Such Payment Request Forms must be submitted with an accounting of expenditures organized by project.

D. The Vigo County Commissioners/City of Terre Haute may require evidence furnished by the Grantee that the project is materially compliant with the timeline provided in the Claim Form. All payments are subject to the Vigo County Commissioners/City of Terre Haute's determination that the Grantee's performance to date conforms with the project as approved, notwithstanding any other provision of this Grant Agreement.

E. Payment Request Forms must be submitted to the Vigo County Commissioners/City of Terre Haute within thirty (30) calendar days following the end of the month work on or for the project was performed. The Vigo County Commissioners/City of Terre Haute may refuse to pay any claims submitted later than sixty (60) calendar days following the end of the month in which the services were provided. Claims may be submitted monthly only. Grant funds that have been advanced and unexpended when the final claim is submitted must be returned to the Vigo County Commissioners/City of Terre Haute.

F. Payment Request Forms must be submitted with accompanying supportive documentation, as designated by the Vigo County Commissioners/City of Terre Haute. Payment Request Forms submitted without supporting documentation will be returned to the Grantee and not processed for payment. Failure to correct said issues may result in the denial of a claim for payment.

7. Project Monitoring by the Vigo County Commissioners/City of Terre Haute.

A. The Vigo County Commissioners/City of Terre Haute may conduct on-site or off-site monitoring reviews of a Project during the term of this Grant Agreement and for up to ninety (90) days after it expires or is otherwise terminated. The Grantee must extend to the Vigo County Commissioners/City of Terre Haute and its authorized designees its full cooperation and give full access to its Project sites and relevant documentation to determine, among other things:

(1) Whether Project activities are consistent with those outlined in the Claim Form, including any modification agreed to by the Vigo County Commissioners/City of Terre Haute and the terms and conditions of the Grant Agreement;

(2) The actual expenditure of state, local, or private funds expended to date on the Project conforms with the amounts for each Project Budget and the Claim Form, and that unpaid costs have been properly accrued;

(3) That Grantee is making timely progress with the project and that its project management, financial management, control systems, procurement systems, methods, and overall performance are in conformance with the requirements outlined in this Grant Agreement and are fully and accurately reflected in Project reports submitted to the Vigo County Commissioners/City of Terre Haute.

B. The Grantee must submit for the Vigo County Commissioners/City of Terre Haute's approval for any public events or announcements related to Grant projects, such as ribbon cuttings, press announcements, celebrations, or similar events. Grantee must coordinate all public events and announcements through the Vigo County Commissioners/City of Terre Haute.

8. Compliance with Audit and Reporting Requirements; Maintenance of Records.

A. The Grantee and any fiscal agent of Grantee shall submit to an audit by the State, or its authorized designee, of funds paid through this Grant Agreement and shall make all books, accounting records, and other documents available at all reasonable times during the term of this Grant Agreement and for five (5) years after final payment for inspection by the Vigo County Commissioners/City of Terre Haute or its authorized designee. One (1) Copy shall be furnished to the Vigo County Commissioners/City of Terre Haute at no cost.

B. Grantee shall arrange for a financial and compliance audit that complies with 2 C.F.R. 200.500 *et seq*. if required by applicable provisions of 2 C.F.R. 200 (Uniform Administrative Requirements, Cost Principles, and Audit Requirements).

C. Separate and apart from the Grantee's status in Paragraph 8.B, if the Grantee is a non-governmental unit, the Grantee shall file the Form E-1 annual financial report required by IC § 5-11-1-4. The E-1 entity annual financial report will determine audit requirements for non-governmental units under IC § 5-11-1-9. Audits under this section must comply with the State Board of Accounts ("SBA") Uniform Compliance Guidelines for Examination of Entities Receiving Financial Assistance from Governmental Sources, found at: https://www.in.gov/sboa/files/guidelines-examination-entities-receiving-financialassistance-government-sources.pdf, as amended from time to time.

9. Compliance with Laws.

A. The Grantee and the Vigo County Commissioners/City of Terre Haute shall work together to comply with all applicable federal, state, and local laws, rules, regulations and ordinances, and all provisions, including but not limited to federal laws and guidance of the ARPA Act, U.S. Treasury guidance and policies, OMB and SBA policies and procedures for reporting, SBA

guidance on administration and tracking of federal COVID funds, and any policies or procedure implemented by the Vigo County Commissioners/City of Terre Haute for the administration of the program. All such materials required to be included herein are incorporated by reference. The enactment or modification of any applicable State or federal statute or the promulgation of rules or regulations thereunder after execution of this Grant Agreement shall be reviewed by the Vigo County Commissioners/City of Terre Haute and the Grantee to determine whether the provisions of this Grant Agreement require formal modification.

B. The Grantee and its agents shall abide by all ethical requirements that apply to persons with a business relationship with the Vigo County Commissioners/City of Terre Haute as set forth in IC § 4-2-6, et seq., IC § 4-2-7, et seq. and the regulations promulgated thereunder. If the Grantee knows or would have known with a reasonable inquiry that a State officer, employee, or special State appointee, as those terms are defined in IC 4-2-6-1, has a financial interest in the Grant, the Grantee shall ensure compliance with the disclosure requirements in IC § 4-2-6-10.5 before the execution of this Grant Agreement. If the Grantee is unfamiliar with these ethical requirements, the Grantee should refer any questions to the Indiana State Ethics Commission or visit the Inspector General's website at http://www.in.gov/ig/. If the Grantee or its agents violate any applicable ethical standards, the Vigo County Commissioners/City of Terre Haute may terminate this Grant immediately upon notice to the Grantee. In addition, the Grantee may be penalized under IC §§ 4-2-6, 4-2-7, 35-44.1-1-4, and any other applicable laws.

C. The Grantee certifies by entering into this Grant Agreement that, to its knowledge, it is not presently in arrears in payment of taxes, permit fees, or other statutory, regulatory, or judicially required payments to the State. Additionally, payments may be withheld, delayed, or denied, or this Grant suspended until the Grantee is current in its payments and has submitted proof of such payment to the Vigo County Commissioners/City of Terre Haute.

D. The Grantee warrants that, to its knowledge, it has no current, pending, or outstanding criminal, civil, or enforcement actions initiated by the State and agrees that it will immediately notify the Vigo County Commissioners/City of Terre Haute of any such actions. During such actions, the Grantee agrees that the Vigo County Commissioners/City of Terre Haute may suspend funding for the project.

E. The Grantee warrants that, to the best of its knowledge, the Grantee and any contractors performing work in connection with a Project shall obtain and maintain all required permits, licenses, registrations, and approvals and shall comply with all health, safety, and environmental statutes, rules, or regulations in the performance of work activities for the State. Failure to do so may be deemed a material breach of this Grant Agreement and grounds for immediate termination and denial of grant opportunities with the State.

F. The Grantee affirms that if it is an entity described in Indiana Code Title 23, it is properly registered and owes no outstanding reports to the Indiana Secretary of State.

G. If the Vigo County Commissioners/City of Terre Haute is asked by the State Budget Agency or any agency or instrumentality of the Federal government to repay any Grant funds that the Vigo County Commissioners/City of Terre Haute has disbursed to Grantee, the Grantee shall, within thirty (30) days, reimburse those funds to the Vigo County Commissioners/City of Terre Haute.

H. As required by IC § 5-22-3-7, the Grantee certifies that:

(1) The Grantee, an affiliate of the Grantee, or any agent acting on behalf of the Grantee or an affiliate has not violated the terms of IC § 24-4.7 [Telephone Solicitation Of Consumers]; IC § 24-5-12 [Telephone Solicitations]; or IC § 24-5-14 [Regulation of Automatic Dialing Machines] in the previous three hundred sixty-five (365) days; and

(2) The Grantee, an affiliate of the Grantee, or any agent acting on behalf of the Grantee or an affiliate will not violate the terms of IC § 24-4.7 for the duration of this Grant Agreement.

I. The Grantee must complete and return the Information and Questionnaire.

J. Notwithstanding anything herein to the contrary, any obligation, duties, or compliance responsibility set forth under this Grant Agreement on Grantee shall rest solely with said Grantee entity and not be an obligation, duty, or compliance responsibility of the individual volunteer commissioner, member, officer, agent, or representative serving said Grantee entity, except for any intentional malicious actions by such individual.

10. Debarment and Suspension.

A. The Grantee certifies by entering into this Grant Agreement that it is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from entering into this Grant Agreement by any federal agency or by any department, agency, or political subdivision of the State.

B. The Grantee certifies that it has verified the suspension and debarment status for all subcontractors or vendors receiving funds under this Grant Agreement and will be solely responsible for any recoupments or penalties that might arise from non-compliance. The Grantee must immediately notify the Vigo County Commissioners/City of Terre Haute if any subcontractor becomes debarred or suspended and must, at the Vigo County Commissioners/City of Terre Haute's request, take all steps required by the Vigo County Commissioners/City of Terre Haute to terminate its contractual relationship with the subcontractor for work to be performed under this Grant Agreement.

11. Drug-Free Workplace Certification.

A. As required by Executive Order No. 90-5, April 12, 1990, issued by the Governor of Indiana, the Grantee covenants and agrees to make a good faith effort to provide and maintain a drug-free workplace. Grantee will give written notice to the Vigo County Commissioners/City of Terre Haute within ten (10) days after receiving actual notice that an employee of the Grantee in the State of Indiana has been convicted of a criminal drug violation in the workplace. False certification or violation of the certification may result in sanctions including, but not limited to, suspension of Grant payments, termination of the Grant, or debarment of grant opportunities with the Vigo County Commissioners/City of Terre Haute for up to three (3) years.

B. In addition to the provisions of the above paragraphs, if the total amount outlined in this Grant Agreement is more than $25,000.00, the Grantee certifies and agrees that it will provide a drug-free workplace by:

(1) Publishing and providing to all of its employees a statement notifying them that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Grantee's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establishing a drug-free awareness program to inform its employees of (1) the dangers of drug abuse in the workplace; (2) the Grantee's policy of maintaining a drug-free workplace; (3) any available drug counseling, rehabilitation, and employee assistance programs; and (4) the penalties that may be imposed upon an employee for drug abuse violations occurring in the workplace;

(3) Notifying all employees in the statement required by subparagraph (A) above that as a condition of continued employment, the employee will: (1) abide by the terms of the statement; and (2) notify the Grantee of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction;

(4) Notifying in writing the Vigo County Commissioners/City of Terre Haute within ten (10) days after receiving notice from an employee under subdivision (C)(2) above, or otherwise receiving actual notice of such conviction; and

(5) Within thirty (30) days after receiving notice under subdivision (C)(2) above of a conviction, imposing the following sanctions or remedial measures on any employee who is convicted of drug abuse violations occurring in the workplace: (1) take an appropriate personnel action against the employee, up to and including termination; or (2) require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, State or local health, law enforcement, or other appropriate agency; and

(6) Making a good faith effort to maintain a drug-free workplace through the implementation of subparagraphs (A) through (E) above.

12. Disputes and Governing Law.

A. In the event of a dispute between the Vigo County Commissioners/City of Terre Haute and the Grantee, other than that addressed by Section 9(D) above, the parties agree to cooperatively negotiate a resolution and escalate to senior management as needed. For any disputes that remain in controversy after thirty (30) days, either party may initiate legal action at its own expense. Both parties agree that disputes shall not be arbitrated.

B. This Grant Agreement shall be governed, construed, and enforced under the laws of the State of Indiana, without regard to its conflict of laws rules. Suit, if any, must be brought in Vigo County, Indiana.

13. Information Technology Accessibility Standards.

Any information technology-related products or services purchased, used, or maintained through this Grant must be compatible with the principles and goals contained in the Electronic and Information Technology Accessibility Standards adopted by the Architectural and Transportation Barriers Compliance Board under Section 508 of the federal Rehabilitation Act of 1973 (29 U.S.C. §794d), as amended from time to time. The federal Electronic and Information Technology Accessibility Standards can be found at: https://www.access-board.gov/ict.html.

14. Insurance.

The Grantee shall maintain insurance with coverages in such amount as may be required by the Vigo County Commissioners/City of Terre Haute or as provided in its Grant Application.

15. Nondiscrimination.

Under the Indiana Civil Rights Law, specifically IC § 22-9-1-10, as amended from time to time, and in keeping with the purposes of the federal Civil Rights Act of 1964, the Age Discrimination in Employment Act, and the Americans with Disabilities Act, the Grantee covenants that it shall not discriminate against any employee or applicant for employment relating to this Grant concerning the hire, tenure, terms, conditions or privileges of employment or any matter directly or indirectly related to employment, because of the employee or applicant's: race, color, national origin, religion, sex, age, disability, ancestry, status as a veteran, or any other characteristic protected by federal, State, or local law ("Protected Characteristics"). Furthermore, Grantee certifies compliance with applicable federal laws, regulations, and executive orders prohibiting discrimination based on the Protected Characteristics in the provision of services.

The Grantee understands that the Vigo County Commissioners/City of Terre Haute is a recipient of federal funds. Therefore, Grantee and subcontractors must comply with requisite affirmative action requirements, including reporting, under 41 CFR Chapter 60 and Section 202 of Executive Order 11246.

16. Notice to Parties.

Whenever any notice, statement, or other communication is required under this Grant Agreement, it will be sent by E-mail or first class U.S. mail service to the following addresses unless otherwise specifically advised.

A.

If funded through Vigo County ARPA dollars:
Vigo County Commissioners
650 S 1st Street
Terre Haute, IN 47802

Copy to:
Vigo County Attorney
401 Ohio Street, Suite A
Terre Haute, IN 47807

Jordan Marvel, Grants Manager
RJL Solutions, 1125 Wabash Avenue, Terre Haute, IN 47807
jmarvel@rjlsolutions.com

If funded through City of Terre Haute ARPA dollars:
Michelle Edwards, City Clerk
Room 102 City Hall
17 Harding Avenue
Terre Haute, IN 47807

Copy to:
City Legal Department
17 Harding Avenue, 2nd Floor
Terre Haute, IN 47807

Jordan Marvel, Grants Manager
RJL Solutions, 1125 Wabash Avenue, Terre Haute, IN 47807
jmarvel@rjlsolutions.com

B. Notices to the Grantee shall be sent to:

Name **Jodi Moan**_____
Title **Executive Director**
Organization **Happiness Bag Players, Inc. dba Happiness Bag, Inc.**___
Email **jodi.moan@happinessbag.org**__

17. Order of Precedence; Incorporation by Reference.

Any inconsistency or ambiguity in this Grant Agreement shall be resolved by giving precedence in the following order: (1) requirements imposed by applicable federal or State law, including those identified in paragraph 9 above; (2) this Grant Agreement; (3) Exhibits prepared by the Vigo County Commissioners/City of Terre Haute; (4) the Grant Management Tool; (5) the Plan; and (6) Exhibits prepared by Grantee. All of the preceding are incorporated fully herein by reference.

18. Public Record.

The Grantee acknowledges that the Vigo County Commissioners/City of Terre Haute will not treat this Grant Agreement as containing confidential information and will post this Grant Agreement on the transparency portal as required by Executive Order 05-07 and IC § 5-14-3.5-2, as amended from time to time. Use by the public of the information contained in this Grant shall not be considered an act of the State.

19. Termination for Breach.

A. Failure of the Grantee, for a Grantee Project, to complete the project and expend Grant funds under this Grant Agreement may be considered a material breach and shall entitle the Vigo County Commissioners/City of Terre Haute to suspend Grant payments associated with the project and to suspend the Grantee's participation in the Vigo County Commissioners/City of Terre Haute grant programs until all material breaches are cured to the Vigo County Commissioners/City of Terre Haute's satisfaction.

B. The Grantee warrants to the Vigo County Commissioners/City of Terre Haute that it will complete its project and expend Grant funds under this Grant Agreement. Breach of this warranty entitles the Vigo County Commissioners/City of Terre Haute to suspend Grant payments associated with the project and the Grantee's receipt of Grant funds.

C. The expenditure of Grant funds other than in conformance with this Grant Agreement may be deemed a breach. The Grantee explicitly covenants that it will repay the Vigo County Commissioners/City of Terre Haute within thirty (30) days all funds not spent in conformance with this Grant Agreement. If the Vigo County Commissioners/City of Terre Haute is subject to any fine, penalty, or fee due to the Grantee's improper expenditure of Grant funds, the Grantee must fully reimburse the Vigo County Commissioners/City of Terre Haute for any incurred expense.

20. Termination for Convenience.

Unless prohibited by a statute or regulation relating to the award of the Grant, this Grant Agreement may be terminated, in whole or in part, by the Vigo County Commissioners/City of Terre Haute whenever, for any reason, the Vigo County Commissioners/City of Terre Haute determines that such termination is in the best interest of the Vigo County Commissioners/City of Terre Haute. Termination will be effected by delivery to the Grantee of a Termination Notice, specifying the extent to which such termination becomes effective. the Vigo County Commissioners/City of Terre Haute will not be liable for work on the project performed after the effective date of termination. In no case shall the total payment to the Grantee exceed the original Grant.

21. Assignment.

The Grantee shall not assign this Grant Agreement without advanced approval from the Vigo County Commissioners/City of Terre Haute. Unauthorized assignment is a material breach of this Grant Agreement.

22. Non-Waiver and Severability.

Failure of either party to insist upon strict performance of any term or condition herein or to exercise any rights or remedies shall not be construed as a waiver of that party's right to assert any of the same or rely on any such term or condition at any time after that. Invalidation of any term, in whole or in part, shall not affect the validity of the other parts.

23. Non-Collusion, Acceptance.

The undersigned attests, subject to the penalties for perjury, that the undersigned is the Grantee or that the undersigned is the properly authorized representative, agent, member, or officer of the Grantee. Further, to the undersigned's knowledge, neither the undersigned nor any other member, employee, representative, agent, or officer of the Grantee, directly or indirectly, has entered into or been offered any sum of money or other consideration for the execution of this Grant Agreement other than that which appears upon the face hereof. Furthermore, if the undersigned knows that a state officer, employee, or special state appointee, as those terms are defined in IC § 4-2-6-1, has a financial interest in the Grant, the Grantee attests to compliance with the disclosure requirements in IC § 4-2-6-10.5, all as amended from time to time.

24. Indemnification.

Unless due to the negligence of the Vigo County Commissioners/City of Terre Haute, the Grantee shall indemnify, defend, and hold harmless the Vigo County Commissioners/City of Terre Haute their respective agents, officers, employees, and representatives from all third party claims and suits for loss or damage

to property, including the loss of use thereof, and injuries to or death of persons, including without limitation any officers, agents, employees, and representatives of the Grantee or its subcontractor(s), and from all judgments recovered and for expenses in defending any such claims or suits, including court costs, attorneys' fees, and for any other expenses caused by an act or omission of the Grantee or subcontractor(s), agents, officers, or employees in connection with the performance of this Grant Agreement. The Vigo County Commissioners/City of Terre Haute shall not provide such indemnification to Grantee.

25. Public Relations and Marketing.

All external communications related to this Grant and the Plan, including but not limited to marketing, public relations, and social media materials and content, shall be developed in consultation with the Vigo County Commissioners/City of Terre Haute and receive the Vigo County Commissioners/City of Terre Haute and Grantee written approval before publication. Communications should include appropriate reference to the Vigo County Commissioners/City of Terre Haute as an investor, partner, or sponsor of the program or initiative that is the subject of this Grant, including the use of the Vigo County Commissioners/City of Terre Haute logo and the Vigo County Commissioners/City of Terre Haute social media tags and reference to the Vigo County Commissioners/City of Terre Haute social media accounts. All communications required under this paragraph shall be sent to Vittoria Meyer, vmeyer@rjlsolutions.com.

26. Use of the Vigo County Commissioners/City of Terre Haute Name.

the Vigo County Commissioners/City of Terre Haute has not granted any rights to use its name, trademark, intellectual property, or logos. The Grantee agrees that it will not use the name or intellectual property, including, but not limited to, the Vigo County Commissioners/City of Terre Haute trademarks or logos, in any manner, including commercial advertising or as a business reference without the prior written consent of the Vigo County Commissioners/City of Terre Haute. In all cases in which the Vigo County Commissioners/City of Terre Haute's participation will be referenced, the Vigo County Commissioners/City of Terre Haute shall have the right to review and approve the use, disclosure, and finished product before publication. All such requests shall be written and delivered to the Vigo County Commissioners/City of Terre Haute for approval at its sole discretion.

27. Obligations Limited to Grantee.

Notwithstanding anything herein to the contrary, any obligation, duties, or compliance responsibility set forth under this Grant Agreement on Grantee shall rest solely with said Grantee entity and not be an obligation, duty, or compliance responsibility of the individual volunteer, commissioner, board member, member, officer, agent, or representative serving said Grantee entity, except for any intentional malicious actions by such individuals.

In Witness Whereof, the Grantee and the Vigo County Commissioners/City of Terre Haute have, through duly authorized representatives, entered into this Grant Agreement. The parties, having read and

understood the preceding terms of this Grant Agreement, do by their respective signatures below, agree to the terms thereof.

Remainder of this page intentionally left blank.

VIGO COUNTY COMMISSIONERS/CITY OF TERRE HAUTE

_____

Signature

_____

Printed Name and Position/Title

Date: _____

GRANTEE: Happiness Bag Players, Inc. dba Happiness Bag, Inc. _____

Signature

Jodi A. Moan, Executive Director

_____

Printed Name and Position/Title

Date: **August 16, 2023**

E-VERIFICATION

"Pursuant to I.C. 5-16-13-11, all employees working on the Project are required to be E-Verified before they can begin working on the project. Contractor and all Subcontractors shall submit the E-Verify case verification number for each individual working on the Project to the Owner prior to the individual beginning work on the Project. An individual is who is required to be verified under I.C. 22-5-1.7 whose final case result is non-confirmation may not be employed on the public works project.

Furthermore, Contractor:

- May not pay cash to any individual employed by the contractor for work done by the individual on the project
- Must be in compliance with the Fair Labor Standards Act and I.C. 22-2-2-1 through I.C. 22-2-2-8
- Must be in compliance with IC 22-3-5-1 and IC 22-3-7-34"

END OF SECTION

CONTRACTOR'S NON – COLLUSION AFFIDAVIT

The undersigned bidder or agent, being duly sworn on oath, says that he has not, nor has any other member, representative, or agent of the firm, company, corporation or partnership represented by him, entered into any combination, collusion or agreement with any person relative to the price to be bid by anyone at such letting nor to prevent any person from bidding nor to include anyone to refrain from bidding, and that this bid is made without reference to any other bid and without any agreement, understanding or combination with any other person in reference to such bidding.

He further says that no person or persons, firms, or corporation has, have or will receive directly or indirectly, any rebate, fee, gift, commission or thing of value on account of such sale.

OATH AND AFFIRMATION

I HEREBY AFFIRM UNDER THE PENALTIES FOR PERJURY THAT THE FACTS AND INFORMATION CONTAINED IN THE FOREGOING BID FOR PUBLIC WORKS ARE TRUE AND CORRECT.

Dated at _____ this _____ day of _____, _____

_____
(Name of Organization)

By_____

_____
(Title of Person Signing)

ACKNOWLEDGEMENT

STATE OF _____)
) ss
COUNTY OF_____)

Before me, a Notary Public, personally appeared the above-named _____ and swore that the statements contained in the foregoing document are true and correct.

Subscribed and sworn to before me this _____ day of _____, _____.

_____
Notary Public

My Commission Expires:_____

County of Residence:_____

BID INFORMATION AND DIRECTION

Happiness Bag works with individuals that have developmental disabilities and special needs. Workers on site should keep their tools and materials secure, vehicles locked and assist in maintaining security. Safety for our friends, customers and fellow workers the highest priority.

Happiness Bag Bid Packages

Bids should include material, labor, equipment and supervision required to perform your scope of work.

Bid packages should include items the industry generally includes in that scope of work.

Items provided by the Construction Manager:

- Site superintendent.
    - Each bidder should include a foreman or supervision for their trade and coordinate work inside their bid package and with the site superintendent.
    - The superintendent will assist with site layout, each trade should verify this layout for compliance with the bid documents.
- Dumpster.
- Site fence and security
- Final clean.
    - All contactors and trades people are expected to clean up after themselves daily. A tidy jobsite is expected for the purpose of safety and professionalism.
- Initial temporary power will come from the existing building.
    - The electrical contractor should work to get permanent power on as soon as possible.
    - The electrical contractor should include temporary lighting as part of their package.
- The garage on the southwest corner of the property will be used as a site office.
- Each trade should plan on providing storage for their work.
- Temporary heat if needed.
- Portable toilet.

Package 1: Excavation, Dirt Work, Site Drainage, Erosion Control

- Soil testing as required for flood plane permits.
- Call in utility locates and pothole for known utilities.
- Provide erosion control.
- Clear & grub all necessary trees/brush.
- Strip topsoil as needed.
    - We do not have soil borings
    - We have done a limited amount of investigation and found near the existing building there is about 30" of topsoil. Approximately 50' north of the existing building we are seeing 14"-21" of topsoil.
    - If you would like to do your own test pits to investigate, contact our office to schedule this.
- Provide site cuts/fills.
- Grade all subgrades.
- Furnish and install site storm water infrastructure.
- Furnish and install site sanitary.
- Furnish and install site water, including 8" water main extension
- Excavate and backfill for perimeter bldg. foundations and 16 column pads
- Furnish and grade gravel under new floor slabs.
- Prep for stoops, walks
- Place & grade topsoil obtained from on site stockpiles.
- Dispose of surplus soils off site.
- Grass seed and straw at the end of the project.

Provide alternate ADD, to furnish and install gravel base under asphalt.

Package 2: Asphalt

- On subgrade prepared by others place and compact stone base course.
- Place and compact HMA base and surface coarse.
- Setup and stripe.
- Provide parking lot signage including but not limited to handicap signs.
- Provide parking bumpers

Provide an alternate DEDUCT to not furnish and install gravel base under asphalt.

Package 3: General Trades

The scope of this package is to include the remainder of the project not called out in other packages.

- Building foundations, slabs, concrete, forms and rebar.
- Additional site concrete, excluding light pole bases.
- Anchor bolts
- Steel building package
- Erection of the steel building, including insulation roofing and siding etc.
    - Provide cranes and equipment as necessary.
    - Rework of the existing building as necessary for connection.
- Rough and finish carpentry.
- Metal studs
- Insulation
- Drywall
- Wood blocking and metal stud bracing as needed.
- Caulking for work in this package.
- Drywall finishing.
- Painting.
- FRP.
- Grid ceilings.
- Floor coverings and epoxy floors.
    - Floor base
- Other interior finishes as called out on the drawings.
- Hollow metal doors, frames, hardware and glazing. Material priced as an allowance from Crossroads Door & Hardware. Cost for this material to be included in your pricing.
- Aluminum storefront and glazing. Hardware for the store front is not included in Crossroads pricing.
- Provide fire extinguishers and cabinets as called out on the life safety plan.
- Lockers or cabinets in the rec room are provided and installed by owner.

Painting of the existing building is to be priced as an ADD alternate.

Package 4: Plumbing & Mechanical

Plumbing

- Provide domestic hot water, cold water, hot water return, sanitary waste and vent systems in the building. Sanitary waste system stubbed 5' outside of the building.
- Domestic water to connect to site/civil blind flange in water room. Water service into water room including blind flange by site/civil contractor.
    - Water meter/ backflow preventor assembly located in water room.
- Provide gas piping system in the building, routed to gas fired equipment. Gas service to building including gas meter assembly by gas company.
- Provide plumbing fixtures, water heaters, water softener, grease trap and related work shown on the plumbing drawings.
- Provide water to refrigerator ice makers as per the drawings.
- Include excavation, backfill and compaction for piping systems located within the building.

Mechanical & HVAC

- Replacing three existing outdoor units and coils as called out.
    - Provide equipment pads
- Provide heating, cooling, HVAC systems as per the drawings.
- Provide return air grills, diffusers, ductwork etc. for a complete installation.
- Thermostats and thermostat wiring.
- Exhaust fans and exhaust fan duct work.
- Dryer vents
- Include roof and wall penetrations and flashings as needed.
- Testing and balancing

Package 5: Electrical

- Coordinate with Duke Energy on the new electrical service
    - Provide panels, switch gear, wiring as called out.
    - Merge the existing building service into the new electrical service
    - The owner is prepared to shut down for one to two days to assist with the service changeover.

- Coordinate with Duke Energy on relocating the electrical service for the garage.
- Provide power to the jobsite off of the permanent electrical service as soon as possible.
- Provide temporary construction lighting.
- Move power for outdoor units that replace/relocate.
- Provide lighting, switching, occupancy sensors and emergency lighting for a complete installation.
- Provide outlets, wiring and power for a complete installation.
- Provide site lighting, including pole bases, needed digging/backfilling and power feeds.
- Provide alarm system as shown.

Data cabling will be donated by: Midwest Technology Cabling. They will include:

- The fiber back bone
- The network cabinet
- Cabling for wall jacks, access points and cameras
    - Includes termination, and plates
- Patch cables for the data rack.

Electrical contractor to provide wall boxes and conduit. See drawings for further details.

Package 6, Fire Suppression/Sprinklers

- Include fire suppression work as described in the bid documents.
- Sprinkler systems shall be hydraulically calculated, fully supervised, and installed according to NFPA 13.
- Contractor shall obtain flow test information prior to design and hydraulic calculation of sprinkler system.
- All sprinkler system items required by code shall be the responsibility of this contractor whether shown on the drawings and specifications or not.
- All fire protection systems to be installed to meet the requirements of the Indiana fire code, 2014; the national fire protection association (NFPA) standard 13, 2010; the national fire protection association (NFPA) standard 14; and Indiana amendments (675 IAC-28-1-5).

- Sprinkler system to connect to site/civil fire service blind flange in water room. Fire service into water room including blind flange by site/civil contractor.
    - Double detector check valve assembly and sprinkler risers located in water room.
    - Fire department connection and Post Indicator Valve located in yard as per the drawings.

Bid Form Happiness Bag New Facilities

Bid submitted by:

(name) _____

(address) _____

(phone number) _____

(email address) _____

(date) _____

Name of foreman & years of experience: _____

Please mark no bid, for any package you are not bidding.

Addendums received & dates: _____

_____

_____

Package 1: Excavation, Dirt Work, Site Drainage, Erosion Control

_____ $ _____

State amount in words

Alternate: Provide alternate ADD, to furnish and install gravel base under asphalt.

_____ $ _____

State amount in words

_____

Package 2: Asphalt

_____ $_____

State amount in words

Provide an alternate DEDUCT to not furnish and install gravel base under asphalt.

_____ $_____

State amount in words

Package 3: General Trades

_____ $_____

State amount in words

Package 4: Plumbing & Mechanical

_____ $_____

State amount in words

Package 5: Electrical

_____ $_____

State amount in words

Package 6, Fire Suppression/Sprinklers

_____ $_____

State amount in words

Please identify subcontractor for work exceeding $30,000.00.

SUPPLEMENTAL GENERAL CONDITIONS

1. COPIES OF DOCUMENTS

Copies of the Contract Documents shall be obtained as directed by the Owner.

2. BONDS AND INSURANCE

A. The Contractor shall not commence work under this contract until they have obtained all insurance required by these specifications and until such insurance has been approved by the Owner, nor shall the Contractor allow any Subcontractor to commence work on their subcontract until all similar insurance required of the Subcontractor has been obtained and approved. Policies expiring on a fixed date before final acceptance of the project must be renewed and evidence of such renewal submitted to the Owner before such date.

B. The Contractor shall furnish the Owner with satisfactory evidence of the insurance required.

C. All policies and/or policy certificates shall contain the following clauses:

1. Worker's Compensation Insurance: The Contractor shall maintain during the life of this contract Worker's Compensation Insurance for all his employees employed at the site of the project, and, in case any work is sublet, the Contractor must require the Subcontractor similarly to provide Worker's Compensation Insurance for all of his employees engaged in work under this contract at the site of the project. The Contractor shall provide insurance coverage equal to that provided under the Worker's Compensation Act, for the protection of his employees not otherwise protected. Employers liability coverage must be maintained in amounts not less than 100,000/500,000/100,000.

2. Public Liability Property Damage: The Contractor shall maintain during the life of this contract Commercial General Liability Insurance. Such coverage shall protect him and any Subcontractor performing work covered by this contract, from claims for damages for personal injury, including accidental death, as well as from claims for property damages, which may arise from operations under this contract, whether such operations be by himself or by any Subcontractor or by anyone directly or indirectly employed by either of them and the amounts of such insurance shall be as follows:

   Commercial General Liability insurance in an amount not less than $1,000,000 per occurrence for Bodily Injury, Property Damage, Personal and Advertising Injury with a $1,000,000 general aggregate and a $1,000,000 Products and Completed Operations aggregate.

   The Contractor shall require all of its Subcontractors, if not protected under Contractor's insurance policies, to effect and maintain, at their own expense during the entire period of performance and until completion of the subcontract, Commercial General Liability Insurance with a company or companies to the satisfaction of the Owner, as follows:

a. Commercial General Liability Insurance in an amount not less than $1,000,000 per occurrence for Bodily Injury, Property Damage, or accidental death with a $2,000,000 general aggregate and a $1,000,000 Products and Completed Operations aggregate.

b. Special hazards not covered under the Commercial General Liability Insurance must be covered on a policy within the amounts as required above.

3. Business Auto Insurance: The Contractor and all Subcontractors shall at all times during the life of this contract, and any other subcontracts, maintain at their own expense, respectively, business auto insurance covering all liability and claims arising from the use and operation, anywhere in the United States, in connection with the performance of the Contract of Subcontracts of automobiles, whether such are owner, hired, or non-owned by the Contractor or Subcontractors. Such auto insurance shall be written with a limit of not less than $1,000,000 per occurrence as a combined single limit for Bodily Injury and Property Damage coverage.

4. Umbrella Liability: The Contractor and all Subcontractors shall maintain during the life of this contract, Umbrella Liability Insurance providing excess coverage over the above specified primary insurance in an amount not less than:

a. $1,000,000 for contracts UNDER $100,000.00.
b. $2,000,000 for contracts OVER $100,000.00.

5. Additional Insurance Requirements: The Contractor and all Subcontractors in connection with the above mentioned Worker's Compensation Insurance shall furnish to the Owner a duly executed certificate of compliance, as prescribed by the Indiana Worker's Compensation Board showing that such insurance is in full force and effect.

With regard to the above mentioned General Liability Insurance, if in the event of any major change or cancellation of such policy, the Contractor and all Subcontractors shall give 30-day advance notice to the Owner.

Also, the Contractor and all Sub-contractors shall make the Owner, as stated in the "Instructions to Bidders", additional insured on their Business Auto and General Liability policies with regard to this Contract.

The Contractor and all Subcontractors shall be required to furnish to the Owner duly executed certificates of insurance showing that all insurance policies required under this contract have been issued and are in full force and effect at all times during the life of this contract and have named the Owner, as stated in the "Instructions to bidders", additional Insured. These certificates are to include General Liability, including contractual coverage, Business Auto and Umbrella Liability.

The "Contractor" will name the "Owner", and any other parties specified, as an "Additional Insured" under the Commercial General Liability Policy. This "Additional Insured" coverage shall be on Form CG2010, or its equivalent, including "completed operations" coverage. The "Additional Insured" coverage provided to the Owner shall be primary coverage, and non-contributory as respects the Owners Liability policy.

6. Loss or Damage: The Owner will obtain all Builders Risk Insurance Polices for this Project.

7. Indemnification: To the fullest extent permitted by law, the Subcontractor expressly agrees to defend (at Subcontractor's expense and with counsel acceptable to the Contractor), indemnify, and hold harmless Owner, Contractor, Architect, Architect's Consultants, Engineer, Construction Manager, Lender, and any other parties which Contractor has agreed to indemnify as named or referenced in the project contract documents as attached to and made a part of this Subcontract, and their respective Officers, Directors, Shareholders, Employees, Agents, Successors, Affiliates, and Assigns from and against any and all claims, suits, losses, causes of action, damages, liabilities, fines, penalties and expenses of an kind whatsoever, including without limitation arbitration or court costs and attorney's fees, arising on account of or in connection with injuries to or the death of any person, or any and all damages to property including loss of use, from or in any manner connected with the work performed by or for the Subcontractor under this Subcontract, caused in whole or in part by the presence of the person or property or the negligent acts or omissions of the Subcontractor or any of its Employees, Agents, Representatives, Sub-Subcontractors, or suppliers or anyone for whose acts they may be liable, including without limitation such claims, damage, loss of expense caused in part by the negligent acts or omissions of a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Paragraph.
   The defense and Indemnification obligations under this Subcontract agreement shall not be restricted in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Subcontractor under workers' compensation acts, disability benefits acts, or other employee benefits acts, and shall extend to and include any actions brought by or in the name of any employee of the Subcontractor or any third party to whom Subcontractor may subcontract a part or all of the work.

SUBCONTRACTORS:

A. Prior to the awarding of the Contract, the contractor shall submit to the Owner, in writing, the names of the proposed Subcontractors and major material vendors. The Contractor shall furnish the Owner with full information concerning the proposed Subcontractor's ability and qualifications at the time such Subcontractor is submitted for approval.

B. The Contractor shall be responsible for the acts and omissions of his Subcontractors and of persons either directly or indirectly employed by them as he is for the acts and omissions of persons directly employed by him.

C. Nothing contained in the Contract shall create any contractual relationship between any Subcontractor and the Owner, and no Subcontractor will be recognized as a party to the Contract.

3. TAXES

The Contractor shall pay all unemployment, social security, and other such taxes imposed by local, state, or federal government.

The Owner is **NOT** subject to Indiana Retail Sales Tax and Federal Excise Tax, these taxes should **NOT** be included in the Contractor's bid.

4. SAFETY AND PROTECTION

OCCUPATIONAL SAFETY AND HEALTH ACTS:

These construction documents, and the joint and several phases of construction hereby contemplated are to be governed at all times by the applicable provisions of the state and federal laws included, but not limited to, the latest amendments of the following:

1. Indiana Occupational Safety and Health Act.

2. Williams-Steiger Occupational Safety and Health Act of 1970 Public Law 81-596; Part 1910-Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations; Part 1518-Safety and Health Regulations for Construction, Chapter XIII of Title 29, Code of Federal Regulations.

3. The REMOVAL of all asbestos associated with this project shall be in conformance with all Governing Codes for removal.

The Contractor shall assume full responsibility for health and safety at the construction site, including, but not limited to, the above mentioned laws and regulations.

5. PAYMENTS TO CONTRACTOR AND COMPLETION

Progress payments will be made monthly based on an approved Application for Payment, and will include work completed, as well as payment on material and equipment delivered and suitably stored at the site, less retainer of 10% of the amount of each, less the aggregate of previous payments in each case. Contractor must include with application, proof of purchase and delivery of materials and equipment stored.

6. SHOP DRAWINGS AND SAMPLES

See Section 01300 Submittals and Section 01340 Shop Drawings, Product Data, & Samples for information on these items.
No material shall be delivered to the project until final approved shop drawings are in the hands of the Owner and Architect and no shop drawings shall be used on the project that do not bear the Architect/Engineer's stamp of approval.

7. EQUAL EMPLOYMENT OPPORTUNITY:

Attention of Bidders is particularly called to the requirement for ensuring that employees and applicants for employment are not discriminated against because of their race, creed, sex, sexual orientation, or national origin.
Attention of Bidders is also particularly called to the requirements for ensuring that, to the greatest extent feasible, in connection with work covered by this contract, opportunities for training and employment be made available to lower income residents of the project area and that contract work shall be awarded to business concerns which are located in or owned substantially by residents of the Project Area.

7. PERFROMANCE OF WORK:

General Contractor will need to provide a list of subs and supplies with estimates for the amount of work (in dollars) to be performed by everyone, including the General Contractor

Contractor agrees and acknowledges that it will perform at least 15% of the total contract price with its own labor, services and materials. Contractor, upon request, shall provide Owner with documentation to demonstrate that it has satisfied this requirement.

Pursuant to the requirements of I.C. 4-13.6-4-2.5 the contractor awarded the contract (as well as any subcontractors performing over $300,000 of work) must be qualified by the Indiana Department of Administration’s Certification Board. Bidders are also advised that this Project shall be subject to the requirements of I.C. 5-16-13, including the requirements that the prime contractor must perform at least 15% of the total contract price with its own labor, services or materials. In addition, bidders are advised that time is of the essence in completing the Project and the contractor will be subject to liquidated damages if the work is not completed within the Project deadlines.

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

The work on this project is to comply with all of the governing codes stated herein.

1.2 GOVERNING CODES

1. All work shall be performed in accordance with the 2015 International Building Code as adopted by the State of Indiana.

2. This Code also adopts the 2017 National Electrical Code, the 2015 International Mechanical Code, and the 2015 International Plumbing Code.

3. All work shall also be performed according to any city and county regulations or codes.

4. All trenching and excavations shall be properly designed by the Excavator in accordance with OSHA and IOSHA excavation regulations.

5. Job safety shall be adhered to by all Contractors on the project in accordance with OSHA and all governing bodies.

PART 2: PRODUCTS (Not Applicable)

PART 3: EXECUTION (Not Applicable)

END OF SECTION

PART 1-GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division I Specification sections, apply to work of this section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The Project: Happiness Bag – New Facilities

1. Project Location: 3833 Union Road
Terre Haute, Indiana 47802

2. Owner: Happiness Bag
3833 Union Road
Terre Haute, Indiana 47802

B. Contract documents dated (Varies) were prepared by:
1. Holder Design, Inc.
24 South 5th Street
Terre Haute, IN 47807

C. The Work includes all labor, material, equipment, tools, and services required for the Happiness Bag – New Facilities project. A listing of the major products and systems included in the Work is indicated by the Table of Contents in the Project Manual.

D. The Work will be completed under a single prime contract.

1.3 COORDINATION

A. General: The Contract includes coordination of entire work of project including preparation of general coordination drawings/diagrams/schedules, and control of site utilization; from the beginning of activity, through the project close-out and warranty periods.

B. The Owner will not be occupying portions of the building during construction. However, the owner shall be allowed access to the site at all times.

1.4 ALTERNATES

A. Definitions: Alternates are defined as alternate products, materials, equipment or systems for the work, which may, at Owner's option and under terms established by Instructions to Bidders, be selected and recorded in (Owner-Contractor Agreement) to either supplement or displace corresponding basic requirements of contract documents. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "allowances", "unit prices", "change orders", "substitutions", and other similar provisions.

B. General Provisions: A "Schedule of Alternates" is included at end of this section. Each alternate is defined by abbreviated language, recognizing that drawings and

specification sections document the requirements. Coordination of related work is required to ensure that work effected by each selected alternate is complete and properly interfaced with work of alternates.

1.5 ALLOWANCES

A. General: A "Schedule of Allowances", showing amounts included in each prime Contract Sum, is included at the end of this section. Coordinate allowance work with related work, to ensure that each selection is completely integrated and interfaced with related work. Requirements for work of allowance are shown and specified to extent established by date of contract documents; additional requirements are established by change order. At earliest possible date, advise Architect/Engineer of date each final allowance selection must be completed. Submit proposals for allowance work as directed, and in a manner specified for change orders. Indicate quantities, unit costs, total purchase amounts, taxes, delivery charges and trade discounts. Where requested, furnish detailed breakdown of quantity survey. Contractor mark-up on overrun of allowance purchases will be permitted where purchase amount exceeds established allowance by more than 15%; otherwise, and except as otherwise indicated, amount of change order on each allowance will be difference between purchase amount and allowance. Deliver excess materials of allowance work to Owner's storage space, or dispose of by other means as directed.

B. Unit-Cost Allowances: Change Order amount will be difference between unit purchase amount and unit-cost allowance, multiplied by final measure or count of work-in-place, including reasonable margins for applicable cutting losses, tolerances, mixing wastes, product imperfections and similar margins. Owner reserves right to establish final measure or count of work-in-place by independent quantity surveyor.

1.6 CUTTING AND PATCHING

A. Definition: Includes cutting and patching of both previously existing work and nominally completed portions of Contract work. Excludes shop fabrication of work, and normal installation procedures including the drilling of holes to install fasteners. Excludes special categories, grading, planting, cleaning, removal/replacement of noncomplying work and similar activities; although some of these activities may require cutting and patching.

B. General: Specific requirements and limitations for cutting and patching are shown and specified for certain types of work, and specified in other sections of Division I as required quality control procedures for general application to performance of the work.

1.7 PERFORMANCE REQUIREMENTS FOR COMPLETED WORK

A. General: The contract documents indicate intended occupancy and utilization of building or site and its individual systems and facilities. Compliance with governing regulations is intended and required, for the work and for Owner's occupancy and utilization.

1.8 DISPOSAL OF WASTE MATERIAL

A. All waste material and debris resulting from Work of this Contract shall be removed from the site by Contractor and disposed of in a legal manner.

1.9 SCHEDULING/LIQUIDATED DAMAGES

A. Construction shall commence within 10 calendar days of Notice to Proceed, and be completed within the time frame agreed upon by the Owner.

B Liquidated damages will not be implemented on this project at this time.

1.10 SCHEDULE OF ALLOWANCES

A. Allowance 1: Door and Door Hardware: $53,000.00, Refer to Crossroads Door and Hardware Inc.

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 WORK AND DEFINITION OF PARTIES

A. The work described herein and illustrated on the accompanying drawings is to comprise all materials and labor for the General Construction and Demolition work as shown on the drawings and specified herein for this project.

B. Wherever the word "Owner" is used herein, it refers to Vigo County Public Library.

C. Wherever the word "Architect" is used herein, it refers to Holder Design, Inc., 24 South 5th Street, Terre Haute, Indiana 47807.

D. Wherever the word "Contractor" is used herein, it refers to the Contractor or Contractors for any part or parts of the work covered by these specifications and the accompanying drawings. The work will be completed under a single prime contract as directed by the Owner.

1.2 SCOPE OF GENERAL CONDITIONS AND ALL CONTRACT DOCUMENTS

A. The General Conditions and all contract Documents shall govern in any subcontract made for any part or parts of the General Construction and Demolition work in this project.

1.3 COORDINATION

A. General: The Contract includes coordination of entire work of project including preparation of general coordination drawings/diagrams/schedules, and control of site utilization; from the beginning of activity, through the project close-out and warranty periods.

1.4 DUPLICATING

A. It is understood that work not indicated on a part of the drawings but reasonably implied to be similar to that shown at corresponding places on other drawings, is to be repeated.

1.5 CUTTING, PATCHING AND DIGGING

A. Each Contractor shall do all cutting, fittings, or patching of his work that may be required to make its several parts come together properly and fit to work with other Contractors, as shown or reasonably implied by the drawings and specifications, or as the Architect and Owner may direct.

B. Any cost of defective or ill-time work shall be borne by the party responsible, therefore.

C. Contractor shall not endanger any work cutting, digging, or otherwise and shall not cut or alter the work of any Contractor except with the consent of the Architect and Owner.

1.6 DIVISION OF WORK

A. All mechanical, ventilating, electrical "rough-in", and final connection for equipment, shall be done by the respective Contractor for that work from drawings furnished, unless otherwise specifically noted.

1.7 VERIFYING MEASUREMENTS

A. The Contractor shall verify all measurements and be responsible for mistakes they may make and their result. If the Contractor discovers any discrepancy in figures on the drawings, they shall report same to the Architect before proceeding with any work affected by the discrepancy, and shall be held responsible for results should they fail to make such report.

1.8 PERFORMANCE REQUIREMENTS FOR COMPLETED WORK

A. General: The contract documents indicate intended occupancy and utilization of building or site and its individual systems and facilities. Compliance with governing regulations is intended and required, for the work and for Owner's occupancy and utilization.

1.9 DISPOSAL OF WASTE MATERIAL

A. All waste material and debris resulting from Work of this Contract shall be removed from the site by Contractor and disposed of in a legal manner.

1.10 SCHEDULING/LIQUIDATED DAMAGES

A. Construction shall commence within the time frame presented by the Owner.

1.11 WORK IN THIS CONTRACT

A. It is the intent of this Section to outline the main work items included in this Contract, not all work items, so the Contractor can have an overview of the scope of the project.

B. Happiness bag – New Facilities:

i. Refer to drawings for all new work requirements for this project.
ii. The scope of the work encompasses approximately 13,000 square feet of new PEMB structure and upfit to house the Happiness Bag New Facilities, including but not limited to the following:
    1. Complete interior/exterior renovation of the main structure and garage out-building
    2. Sitework per drawings
    3. New PEMB structure(s)
    4. New plumbing lines, fixtures, finishes and restroom accessories
    5. New ceilings, lighting, diffusers, and grills
    6. New electrical panels, outlets

1.8 DEMOLITION

A. All demolition work shall be done in a workman like manner in order cause no more disturbance to operations than necessary. Coordinate demolition with the contact.

B. All debris to be removed from site by contractor except for those items stated on the drawings which are to be removed and taken to a designated area for storage and remain the property of the owner.

C. Refer to "Instructions to Bidders" for additional information.

PART 2: PRODUCTS (Not Applicable)

PART 3: EXECUTION (Not Applicable)

END OF SECTION

SECTION 01068 - REFERENCE STANDARDS AND DEFINITIONS

PART 1: GENERAL

The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 RELATED DOCUMENTS

A. General: Basic Contract definitions are included in the General and Supplementary Conditions and other Division I Specification sections; apply to work of this section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the General Conditions.

B. Indicated: The term "indicated" refers to graphic representatives, notes, or schedules on the Drawings, other Paragraphs of Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown", "noted", "scheduled" are used, it is to help the reader locate the reference; no limitation on location is intended.

C. Directed: Terms such as "directed", "requested", "authorized", "selected", “approved", “required” , and "permitted", mean "directed by the Architect", "requested by the Architect", and similar phrases.

D. Approved: The term "approved", where used in conjunction with the Architect’s action on the Contractor's submittals, applications, and requests, is limited to the Architect’s duties and responsibilities as stated in the Conditions of the Contract.

E. Or an Approved Equal: The phrase "or an approved equal" means a product or material for which a request for approval was made and for which the Engineer's approval was granted prior to receipt of bids.

F. Regulations: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

G. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."

H. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."

I. Provide: The term "provide" means "to furnish and install, complete and ready for intended use."

J. Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term "experienced" when used with the term "Installer" means having a minimum of five previous project similar in size and scope to this project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.

2. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

3. Assignment of Specialist: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.

a. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the work. It is also not intended to interfere with local trade union jurisdiction settlements and similar conventions.

K. Project Site is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land upon which the project is to be built.

L. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, whether at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 16-Division Format and MASTERFORMAT numbering system.

1. Abbreviated Language: Language used in Specifications and other Contract Documents is the abbreviated type. Words that are implied, but not stated shall be interpolated as the sense required. Singular words interpreted as singular where applicable and the content of the Contract Documents so indicates.

2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.

   a. The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.

   b.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with the standard in effect as of the date of the Contract Documents.

C. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards may establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Engineer for a decision before proceeding.

   1 . Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these. requirements, indicated numeric values are minimum or maximum, as appropriate for the content of the requirements. Refer uncertainties to the Engineer for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on the project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.

   1 . Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

1.5 GOVERNING REGULATIONS/AUTHORITIES

A. The Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents. Contact authorities having jurisdiction directly for information and decisions having a bearing on the work.

1.6 SUBMITTALS

A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the work.

PART 2: PRODUCTS (Not Applicable)

PART 3: EXECUTION (Not Applicable)

END OF SECTION

PART 1: GENERAL

The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division I Specification sections, apply to work of this section.

1.2 DESCRIPTION OF REQUIREMENTS

A. The types of submittal requirements specified in this section include shop drawings, product data, samples and miscellaneous work-related submittals. Individual submittal requirements are specified in applicable sections for each unit of work. Refer to other Division I sections and other contract documents for requirements of administrative submittals.

B. Definitions: Work-related submittals of this section are categorized for convenience as follows:

1. Shop drawings include specially-prepared technical data for this project, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to a range of similar projects.

2. Product data include standard printed information on materials, products and systems; not specially-prepared for this project, other than the designation of selections from among available choices printed herein.

3. Samples include both fabricated and unfabricated physical examples of materials, products and units of work; both as complete units and as smaller portions of units of work; either for limited visual inspection or (where indicated) for more detailed testing and analysis.

4. Mock-ups are a special form of samples, which are too large or otherwise inconvenient for handling in specified manner for transmittal of sample submittals.

5. Miscellaneous submittals related directly to the work (non-administrative) include warranties, maintenance agreements, workmanship bonds, project photographs, survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock, and similar information, devices and materials applicable to the work and not processed as shop drawings, product data or samples.

1.3 GENERAL SUBMITTAL REQUIREMENTS

A. Timing of Submittals: All required submittals shall be made in a timely manner so that

as not to delay the progress of the project, but in no case shall they be made more than 30 days after award of the contract.

B. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and provide space for Architect's/Engineer's "Action" marking. Package each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through Contractor's office will be returned by A/E "without action".

Transmittal Form: Contractor's standard transmittal form.

Provide Contractor's certification on form, ready for execution, stating that information submitted complies with requirements of contract documents.

1.4 SPECIFIC-CATEGORY SUBMITTAL REQUIREMENTS

A. General: Except as otherwise indicated in individual work sections, comply with requirements specified herein for each indicated category of submittal. Provide and process intermediate submittals, where required between initial and final, similar to initial submittals.

B. Shop Drawings: Provide newly-prepared information, on reproducible sheets, with graphic information at accurate scale (except as otherwise indicated), with name of preparer indicated (firm name). Show dimensions and note which are based on field measurement. Identify materials and products in the work shown. Indicate compliance with standards, and special coordination requirements. Do not allow shop drawing copies without appropriate final "Action" markings by Engineer to be used in connection with the work.

1 . Submittals: Submit 5 copies, 3 copies will be returned for contractor's use. Keep one copy at jobs site.

C. Product Data: Collect required data into one submittal for each unit of work or system; and mark each copy to show which choices and options are applicable to project. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked, and special coordination requirements. Maintain one set of product data (for each submittal) at project site, available for reference by Architect/Engineer and others.

1 . Submittals: Do not submit product data, or allow its use on the project, until compliance with requirements of contract documents has been confirmed by Contractor. Submittal is for information and record, unless otherwise indicated. Initial submittal is final submittal unless returned promptly by Architect/Engineer, marked with an "Action" which indicates an observed non compliance. Submit 5 copies, 3 copies will be returned for contractor's use and where required for maintenance manuals.

D. Samples: Provide units identical with final condition of proposed materials or products for the work. Include "range" samples (not less than 3 units) where unavoidable

variations must be expected, and describe or identify variations between units of each set. Provide full set of optional samples where Architect's/Engineers selection is required. Prepare samples to match Architect's/Engineer's sample where so indicated. Include information with each sample to show generic description, source or product name and manufacturer, limitations, and compliance with standards. Samples are submitted for review and confirmation of color, pattern, texture and "kind" by Architect/Engineer. Architect/Engineer will not "test" samples (except as otherwise indicated) for compliance with other requirements, which are therefore the exclusive responsibility of Contractor.

1. Submittal: Provide submittal of 3 sets of samples for Architect's/Engineer's review and "Action". Two sets will be returned. Maintain one set of samples at the job site.

E. Mock-Ups: Mock-ups and similar submittal of 3 sets of samples for Architect's/Engineer's review and "Action". Two sets will be returned. Maintain one set of samples at the job site.

F. Inspection and Test Reports: Classify each as either "shop drawing" or "product data", depending upon whether report is uniquely prepared for project or a standard publication of workmanship control testing at point of production; process accordingly.

G. Warranties: Refer to "Products" section for specific general requirements on warranties, product/workmanship bonds, and maintenance agreements. In addition to copies desired for Contractor's use, furnish 2 executed copies, except furnish 2 additional (conformed) copies where required for maintenance manuals. Refer to Mechanical and Electrical Sections.

H. Closeout Submittals: Refer to individual work sections and to "closeout" sections for specific requirements on submittal of closeout information, materials, tools and similar items.

Record Document Copies: Furnish one set.

Maintenance/Operating Manuals: Furnish 2 bound copies.

1. Materials and Tools: Refer to individual work sections for required quantities of spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.

I. General Distribution: Provide additional distribution of submittals (not included in foregoing copy submittal requirements) to subcontractors, suppliers, fabricators, installers, governing authorities and others as necessary for proper performance of the work. Include such additional copies in transmittal to Architect/Engineer where required to receive "Action" marking before final distribution. Record distributions on transmittal forms.

1.5 ACTION ON SUBMITTALS

A. Except for submittals for the record or for information, where action and return of submittals is required, the Architect or Engineer will review each submittal, mark to

indicate the action taken, and return.

1. Do not permit submittals marked "Revise and resubmit" or "Rejected" to be used in the Work.

PART 2: PRODUCTS (Not Applicable)

PART 3: EXECUTION (Not Applicable)

END OF SECTION

PART 1: GENERAL

The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 MEETINGS

It shall be an obligation of the Contractors to attend a meeting with the Owner and Architect as directed by Architect, during the entire life of the project for the purpose of expediting the work and considering other matters pertaining thereto. Notice of said meetings to originate from the contractors office, unless otherwise noted. Contractor to require his principal Subcontractors to attend.

1.2 PROGRESS SCHEDULE

After award of contract, prime contractors cooperatively shall submit for approval a progress schedule. This schedule shall be worked out and agreed upon by the prime contractors and is intended to act as a means of obtaining closer cooperation and coordination between all contractors involved. The schedule shall be based on work days. It should be remembered that time must be allotted for shop drawings and decisions involving Architect and Owner.

PART 2: PRODUCTS (Not Applicable)

PART 3: EXECUTION (Not Applicable)

END OF SECTION

SECTION 01340 - SHOP DRAWINGS, PRODUCT DATA, & SAMPLES

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submittal of Shop Drawings Product Data and Samples.

1.3 SUBMITTAL PROCEDURES

A. Contractor Reviews: The Contractor shall review and approve all submittals before transmitting them to the Architect/Engineer. Each submittal shall bear the approval stamp of the Contractor or they will be returned by the Architect/Engineer unchecked.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal to the Architect/Engineer sufficiently in advance of scheduled performance of related construction activities to avoid delay. The Architect will then review the submittals or send them on to the appropriate consulting Engineer for review.

1 . Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for re-submittals

2. Submit only the shop drawings, product data, and samples called for in the technical Sections. Any other shop drawings, product data, or samples submitted will be returned unchecked.

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal to the Architect/Engineer and to other destinations by use of a transmittal form. The Architect will return submittals received from sources other than the Contractor.

1 . Record relevant information and requests for data on the transmittal form. On the form, or an attached separate sheet, record deviations from requirements of the Contract Documents, including minor variations and limitations.

2. Include the Contractor's certification stating that information submitted complies with requirements of the Contract Documents.

1.4 SHOP DRAWINGS

A. Submit newly prepared information, drawn accurately to scale. Do not reproduce Contract Documents or copy standard printed information as the basis of Shop Drawings.

1. Include the following information on Shop Drawings:

a. Dimensions.
b. Identification of products and materials included.
c. Compliance with specified standards.
d. Notation of coordination requirements
e. Notation of dimensions established by field measurement.

2. Submit Coordination Drawings where required for integration of different construction elements. Show construction sequences and relationships of separate components where necessary to avoid conflicts in utilization of the space available.

3. Highlight, encircle, or otherwise indicate deviations from the Contact Documents on the Shop Drawings.

4. Do not allow Shop Drawing copies that do not contain an appropriate final stamp or other marking indicating the action taken by the Architect or Engineer to be used in construction.

5. Submittal: Submit 1 reproducible copy and 2 additional blue line or black line prints of each shop drawing. The 2 prints marked with the action taken by the Architect or Engineer will be retained and the reproducible copy will be returned to the Contractor. The Contractor should then make copies from the reproducible that bears the action stamp as suits his needs, including a copy required for Project Record Documents.

1.5 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Mark each copy to show which choices and options are applicable to the Project.

1 . Include the following information in Product Data:

a. Manufacturer's printed recommendations.
b. Compliance with recognized trade association standards.
c. Compliance with recognized testing agency standards.
d. Application of testing agency labels and seals.
e. Notation of dimensions verified by field measurement.

B. Submittals: Submit 5 copies of each required Product Data submittal. Two copies marked with the action taken by the Architect or Engineer will be retained, and the balance will be returned to the Contractor.

1.6 SAMPLES

A. Submit 12" x 12", fully fabricated Samples, cured and finished in the manner specified, and physically identical with the material or product proposed for use.

1 . Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented by a Sample, submit at least 3 multiple units that show approximate limits of the variations.

B. Submittals: Except for Samples intended to illustrate assembly details, workmanship, fabrication techniques, connections, operation, and other characteristics, submit 3 sets of Samples. One set will be returned marked with the action taken.

1.7 ARCHITECT'S/ENGINEER'S ACTION

A. Except for submittals for the record or for information, where action and return of submittals is required. The Architect or Engineer will review each submittal, mark to indicate the action taken, and return.

1 . Do not permit submittals marked "Revise and resubmit" or "Rejected" to be used in the Work.

PART 2: PRODUCTS (Not Applicable)

PART 3: EXECUTION (Not Applicable)

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division I Specification sections, apply to work of this section.

1.2 DESCRIPTION OF REQUIREMENTS

A. Definitions: Specific administrative and procedural minimum actions are specified in this section, as extension of provisions in General Conditions and other documents. These requirements have been included for special purposes as indicated. Nothing in this section is intended to limit types and amounts of temporary work required, and no omission from this section will be recognized as an indication by Architect or Engineer that such temporary activity is not required for successful completion of the work and compliance with requirements of contract documents. Provisions of this section are applicable to, but not by way of limitation, utility services, construction facilities, security/protection provisions, and support facilities.

1.3 QUALITY ASSURANCE

A. General: In addition to compliance with governing regulations and rules/ recommendations of franchised utility companies, comply with specific requirements indicated and with applicable local industry standards for construction work (published recommendations by local consensus "building councils").

B. OSHA: Contractors shall comply with Williams-Steiger, Occupational Safety & Health Act of 1970, Part 1926 (Formerly 1518), Safety & Health Regulations for Construction, Subpart H1926.250 and as amended thereafter.

Comply with Subpart E, 1926.100 through 1926.107 (1518.100 through 1518.107) Subpart H, 1926.251 (1518.251), Subpart I 1926.300 through 1926.305 (1518.300 through 1518.305) Subpart L 1926.450 through 1926.452 (1518.450 through 1518.452) Subpart N 1926.550 through 1926.555 (1518.550 through 1518.555) Subpart O 1926.600 through 1926.606 (1518.600 through 1518.606) of Safety & Health Regulations.

1.4 JOB CONDITIONS

A. Conditions of Use: Install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, non-hazardous, sanitary and protective of persons and property, and free of deleterious effects.

B. Each Contractor shall supply all tools, machinery, centers, hoists, derricks, etc. as required for the complete and satisfactory execution of his work. Each contractor shall provide all guys and anchorage for such apparatus and structures and shall be responsible for any unsafe work in connection with the same.

1.5 TEMPORARY UTILITY SERVICES

A. The types of services required include, but not by way of limitation, water, electrical power and telephone. Contact local utilities for required services during construction.

B. Potable Water: Coordinate with Owner on usage of existing water service at building. Water usage as billed by Indiana American Water Company during construction shall be paid for by the Owner.

C. Temporary Power: Coordinate with Owner on usage of existing electrical service for temporary power. Provide temporary power and lighting as required by all contractors. The Owner shall pay for the cost of the electricity during construction.
The cost of light bulbs used during the construction shall paid for by the Electrical Contractor. Each contractor and/or subcontractor shall furnish any necessary wiring and extension cords to reach from the nearest outlet to his point of operation.

If any contractor requires additional power for use of tools, it will be their responsibility to make these arrangements with the Electrical Contractor.

All elements of the temporary service shall conform to the regulations of the National Electric Code, the National Electric Safety Code and the Safety Code for the Construction Industry, and Part 1926 Safety & Health Regulations for Construction and as amended thereafter.

No permanent power from permanent sources shall be used without the Owner's written permission indicating the conditions whereby it may be used. Consideration will not be given for the use of lights, wiring devices, or other electric equipment until the building is in the finishing stages, or unless it is in the Owner's interests.

1.6 TEMPORARY CONSTRUCTION FACILITIES

A. The types of temporary construction facilities required include, but not by way of limitation, water distribution, heat, ventilation, and electrical power distribution. Provide facilities reasonable required to perform construction operations properly and adequately.

B. Lighting: Provide sufficient temporary lighting to ensure proper workmanship everywhere by combined use of daylight and portable plug-in task lighting. Provide general lighting with local switching which will enable energy conservation during periods varying activity (work-in-progress, traffic only, security check, lock-up, etc.).

1.7 SECURITY/PROTECTION PROVISIONS

A. The types of temporary security and protection provisions required include, but not by way of limitation, fire protection, barricades, warning signs/lights, building enclosure/lockup, personnel security program (theft prevention), environmental protection, and similar provisions intended to minimize property losses, personal injuries and claims for damages at project site.

B. Fire Extinguishers: Provide types, sizes, numbers and locations as would be reasonably effective in extinguishing fires during early stages, by personnel at project site. Provide Type A Extinguishers at locations of low-potential for either electrical or grease-oil-flammable liquids fires; provide Type ABC dry chemical extinguishers at other locations; comply with recommendations of NFPA No. 10. Post warning and quick instructions at each extinguisher location, and instruct personnel at project site, at time of their first arrival, on proper use of extinguishers and other available facilities at project site. IF REQUIRED.

C. Non-Working Hours: All temporary facilities or equipment which would permit unauthorized persons access to the construction area, or building, or roof shall be removed from the site or shall be secured to be unusable during periods when work is not in progress.

D. The work of any Contractor damaged because of failure of the General Contractor to provide the protection above required shall be removed and replaced with new work at the General Contractor's expense.

Each Prime Contractor shall protect his excavations, trenches and structures from damage from rain water, ground water, backing-up of drains and sewers, and from all other water. Provide pumps, equipment and enclosures to provide protection for his own work.

1.8 TEMPORARY SUPPORT FACILITIES

A. The types of temporary support facilities required include, but not by way of limitation, storage sheds, fabrication sheds first aid facilities, signs, clean-up facilities waste disposal service, rodent/pest control and similar miscellaneous general services, all as may be reasonably required for proficient performance of the work and accommodation of persons, at the site including Owner's and Architect's/Engineer's personnel. Discontinue and remove temporary support facilities, and make incidental similar use of permanent work of the project, only when and in manner authorized by Architect/Engineer; and, if not otherwise indicated, immediately before time of substantial completion. Locate temporary support facilities for convenience of users, and for minimum interference with construction activities.

B. Contractor's Field Office: Contractor's temporary field office is not required. If one is provided, locate as directed by Owner.

1 . Contractor shall provide telephones for emergency calls by either providing an office equipped with a telephone or providing a mobile telephone.

C. Temporary Sheds: Contractor shall provide any temporary sheds he needs for storage, fabrication and similar purposes. Locate as directed by Owner.

D. Sanitary Facilities: Contractor shall provide toilets he needs for sanitation. (Single occupant self-contained chemical toilet units, properly vented and fully enclosed with fiber reinforced polyester shell or similar non-absorbent material.) Provide separate toilet facilities for male and female construction personnel when both sexes are employed on site.

E. Cleaning and Trash Removal: Contractor shall provide waste containers sufficient for the deposit of non-hazardous/non-toxic waste materials. Remove such waste materials from the project site at least twice weekly during mild and warm weather (daily high temperatures above 50 degrees F). Remove not less than weekly during periods when daily high temperatures are at or below 50 degrees F.

F. Temporary Walks, Stairs, Ladders, Ramps, and Runways: General Contractor shall furnish and maintain all equipment such as temporary stairs, ramps, chutes, etc. as required for proper execution of the work by all trades, except where specifically mentioned that above is to be furnished and maintained under divisions or sections of contract as hereinafter specified. All above shall comply with Subpart L, 1926.450 through 1926.452 (1518.450 through 1518.452) & Subpart M, 1926.500 through 1926.502 (1518.500 through 1518.502) of Safety & Health Regulations for Construction.

PART 2: PRODUCTS (Not Applicable)

PART 3: EXECUTION (Not Applicable)

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1. 1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division I Specification sections, apply to work of this section.

1.2 DESCRIPTION OF REQUIREMENTS

A. Definitions: "Products" is defined to include purchased items for incorporation into the work, regardless of whether specifically purchased for project or taken from Contractor's stock of previously purchased products. "Materials", is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, installed or applied to form units of work. "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, etc.). Definitions in this paragraph are not intended to negate the meaning of other terms used in contract documents, including "specialties", "systems", "structure", "finishes", "accessories", "furnishings", “special construction", and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Substitutions: The requirements for substitutions do not apply to specified Contractor options on products and construction methods. Revisions to contract documents, where requested by Owner, Architect or Engineer, are "changes" not "substitutions". Requested substitutions during bidding period, which have been accepted prior to Contract Date, are included in contract document and are not subject to requirements for substitutions as specified herein. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute "substitutions"; and do not constitute a basis for change orders, except as provided for in contract documents. Otherwise, Contractor's requests for changes in products, materials and methods of construction required by contract documents are considered requests for "substitutions", and are subject to requirements hereof.

C. Standards: Refer to Division I section "Definitions and Standards" for applicability of industry standards to products of project, and for acronyms used in text of specification sections.

1.3 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of work, provide products, materials or equipment of a singular generic kind from a single source.

B. Finish Materials: Finish materials installed within a single room or area or within contiguous areas, or on the exterior, shall be from a single production run to assure color/pattern/finish consistency. Color, pattern, or finish variations, not represented by the approved samples and judged by the Architect/Engineer to be objectionable will

result in rejection of the material, without regard for whether the variations are caused by inter-mixing of materials from more than one production run, or by Installer not following manufacturer's instructions for blending of material from a single production rim. This paragraph relates to both exterior and interior finish materials.

C. Compatibility of Options: Where more than one choice is available as options for Contractor's selection of a product or material, select an option which is compatible with other products and materials already selected (which may have been from among options for those other products and materials). Compatibility is a basic general requirement of product/material selections.

D. Approved or Acceptable Manufacturers: The specification sections may identify acceptable or approved manufacturers with a paragraph which states the following, or words of the same effect:

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

The manufacturers listed are those that are believed to provide products of acceptable and comparable quality and which satisfy the requirements of the specifications. Since manufacturers, from time to time, change the quality of their products, some manufacturer's products may not conform to the requirements of the specifications. Those manufacturers are hereby advised that specification requirements will not be waived to accept their products simply because they were named as an acceptable or approved manufacturer.

1.4 SUBMITTALS

A. Requests for Substitutions: Submit 3 copies, fully described for product or method being replaced by substitution, including related specification section and drawings number(s), and fully documented to show compliance with requirements for substitutions. Include product data/drawings, description of methods, samples where applicable, Contractor's detailed comparison of significant qualities between specified item and proposed substitution, statement of effect of construction time and coordination with other affected work, cost information or proposal, and Contractor's statement to the effect that proposed substitution will result in overall work equal-to-or-better-than work originally indicated.

1.5 PRODUCT DELIVERY-STORAGE-HANDLING

A. General: Deliver, handle and store products in accordance with manufacturer's recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Control delivery schedules to minimize long term storage of products at site and overcrowding of construction spaces. In particular, provide deliver/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damage, or sensitive to deterioration, theft and other sources of loss.

1.6 WARRANTIES (GUARANTEES)

A. Categories of Specific Warranties: Warranties on the work are in several categories,

including those of General Conditions, and including (but not necessarily limited to) the following specific categories related to individual units of work specified in sections of Divisions 2 through 16 of these specifications:

1 . Special Project Warranty (Guarantee): A warranty specifically written and signed by Contractor for a defined portion of the work; and, where required, countersigned by subcontractor, installer, manufacturer or other entity engaged by Contractor.

2. Specified Product Warranty: A warranty which is required by contract documents, to be provided for a manufactured product incorporated into the work; regardless of whether manufacturer has published a similar warranty without regard for specific incorporation of product into the work, or has written and executed a special project warranty as a direct result of contract documents requirements.

3. Coincidental Product Warranty: A warranty which is not specifically required by contract documents (other than as specified in this Section); but which is available on a product incorporated into the work, by virtue of the fact that manufacturer of product has published warranty in connection with purchases and uses of product without regard for specific applications except as otherwise limited by terms of warranty.

B. Refer to individual sections of Divisions 2 through 16 for the determination of units of work which are required to be specifically or individually warranted, and for the specific requirements and terms of those warranties (or guarantees).

C. General Limitations: It is recognized that specific warranties are intended primarily to protect Owner against failure of the work to perform as required, and against deficient, defective and faulty materials and workmanship, regardless of sources. Except as otherwise indicated, specific warranties do not cover failures in the work which result from: 1) Unusual and abnormal phenomena of the elements, 2) The Owner's misuse, maltreatment or improper maintenance of the work, 3) Vandalism after time of substantial completion, or 4) Insurrection or acts of aggression including war.

D. Related Damages and Losses: In connection with Contractor's correction of warranted work which has failed, remove and replace other work on project which has been damaged as a result of such failure, or must be removed and replaced to provide access for correction of wan-anted work.

1 . Consequential Damages: Except as otherwise indicated or required by governing regulations, special project warranties and product warranties are not extended to cover damage to building contents (other than work of Contract) which occurs as a result of failure of warranted work.

E. Reinstatement of Warranty Period: Except as otherwise indicated, when work covered by a special project warranty or product warranty has failed and has been corrected by replacement or restoration, reinstate warranty by written endorsement for the following time period, stating on date of acceptance of replaced or restored

work.

1 . A period of time equal to original warranty period of time.

F. Replacement Cost, Obligations: Except as otherwise indicated, costs of replacing or restoring failing warranted units or products is Contractor's obligation, without regard for whether Owner has already benefited from use through a portion of anticipated useful services lives.

G. Contractor's Procurement Obligations: Do not purchase, subcontract for, or allow others to purchase or subcontract for material or units of work for project where a special project warranty, specified product warranty, certification or similar commitment is required, until it has been determined that entities required to countersign such commitments are willing to do so.

H. Specific Warranty Forms: Where a special project warranty (guarantee) or specified product warranty is required, prepare a written document to contain terms and appropriate identification, ready for execution (through Architect/Engineer) for approval prior to final executions.

PART 2: PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCES

A. General: The compliance requirements, for individual products as indicated in contract documents, are multiple in nature and may include generic, descriptive, proprietary, performance, prescriptive, compliance with standards, compliance with codes, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with. Also "allowances" and similar provisions of contract documents will have a bearing on selection process.

B. Procedures for Selecting Products: Contractor's options for selecting products are limited by contract document requirements, and governing regulations, and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects. Required procedures include, but are not necessarily limited to, the following for various indicated methods of specifying:

1. Single Product/Manufacturer Name: Provide product indicated, except advise Architect/Engineer before proceeding, where known that named product is not a feasible or acceptable selection.

2. Two or More Product/Manufacturer Names: Provide one of the named products, at Contractor's option; but excluding products which do not comply with requirements. Do not provide or offer to provide an unnamed product, except where none of named products comply with requirements or are a feasible selection; advise Architect/Engineer before proceeding.

3. "Or Equal": Where named products in specifications text are accompanied

by the term "or equal", or other language of similar effect, comply with those contract document provisions concerning "substitutions" for obtaining Architect's/Engineer's approval (by change order) to provide an unnamed product.

4. Standards, Codes and Regulations: Where only compliance with an imposed standard, Code or regulation is required, selection from among products which comply with requirements including those standards, codes and regulations, is Contractor's option.

5. Performance Requirements: Provide products which comply with specific performances indicated, and which are recommended by manufacturer (in published product literature or by individual certification) for application indicated. Overall performance of a product is implied where product is specified with only certain specific performance requirements.

6. Prescriptive Requirements: Provide products which have been produced in accordance with prescriptive requirements, using specified ingredients and components, and complying with specified requirements for mixing, fabricating, curing, finishing, testing, and similar operations in manufacturing process.

7. Visual Matching: Where matching with an established sample is required, final judgment of whether a product proposed by Contractor matches sample satisfactorily is Architects/Engineers judgment. Where no product within specified cost category is available, which matches sample satisfactorily and complies with requirements, comply with contract documents provisions concerning, "substitutions" and "change orders" for selection of a matching product outside established cost category or, of a product not complying with requirements.

8. Visual Selection: Except as otherwise indicated, where specified product requirements include "...as selected from manufacturer's standard colors, patterns, textures..." or words of similar effect, the selection of manufacturer and basic product (complying with requirements) is Contractor's option, and subsequent selection of color, pattern and texture is Architects/Engineers selection.

2.2 SUBSTITUTIONS

A. Conditions: Contractor's request for substitution will be received and considered when extensive revisions to contract documents are not required and changes are in keeping with general intent of contract documents; when timely, fully documented and properly submitted; and when one or more of the following conditions is satisfied, all as judged by Architect/Engineer. Otherwise, requests will be returned without action except to record non-compliance with these requirements.

1 . Where required product, material or method cannot be provided within Contract Time, but not as a result of Contractor's failure to pursue the work promptly or to coordinate various activities properly.

2. Where required product, material or method cannot be provided in a manner which is compatible with other materials of the work, or cannot be properly coordinated therewith, or cannot be warranted as required, or cannot be used without adversely affecting Owner's insurance coverage on completed work, or will encounter other substantial non-compliances which are not possible to otherwise overcome except by making requested substitution, which Contractor thereby certifies to overcome such non-compatibility, non coordination, non-warranty, non-insurability or other non-compliance as claimed.

3. Where required product, material or method cannot receive required approval by a governing authority, and requested substitution can be so approved.

a. Submit within 10 days of Notice To Proceed, any proposed substitutions with reason for the substitution as outlined above.

B. Work-Related Submittals: Contractor's submittal of, and Architect’s/Engineer's approval of, shop drawings, product data or samples which relate to work not complying with requirements of contract documents, does not constitute an acceptable or valid request for a substitution, nor approval thereof.

2.3 GENERAL PRODUCT REQUIREMENTS

A. General: Provide products which comply with requirements, and which are undamaged and unused at time of installation, and which are complete with accessories, trim, finish, safety guards, and other devices and details needed for complete installation and for intended use and effect.

B. Nameplates: Except as otherwise indicated for required approval labels, and operating data, do not permanently attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view either in occupied spaces or on exterior of the work.

1. Labels: Locate required labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface which, in occupied spaces, is not conspicuous.

2. Equipment Nameplates: Provide permanent nameplate on each item of service-connected or power operated equipment. Indicate manufacturer, product name, model number, serial number, capacity, speed, ratings and similar essential number, capacity, speed, ratings and similar essential operating data. Locate nameplates on an easily accessed surface which, in occupied spaces, is not conspicuous.

PART 3: EXECUTION (Not Applicable)

END OF SECTION

PART 1-GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division I Specification sections, apply to work of this section.

1.2 DESCRIPTION OF REQUIREMENTS

A. Definitions: Closeout is hereby defined to include general requirements near end of Contract Time, in preparation for final acceptance, final payment, normal termination of contract, occupancy by Owner and similar actions evidencing completion of the work. Specific requirements for individual units of work are specified in sections of Division 2 through 16. Time of closeout is directly related to "Substantial Completion", and therefore may be either a single time period for entire work or a series of time periods for individual parts of the work which have been certified as substantially complete at different dates. That time variation (if any) shall be applicable to other provisions of this section.

1.3 PREREQUISITES TO SUBSTANTIAL COMPLETION

A. General: Prior to requesting Architect' s/Engineer's inspection for certification of substantial completion (for either entire work or portions thereof), complete the following and list known exceptions in request:

1 . In progress payment request, coincident with or first following date claimed, show either 100% completion for portion of work claimed as "substantially complete", or list incomplete items, value of incompletion, and reasons for being incomplete.

2. Include supporting documentation for completion as indicated in these contract documents.

3. Submit statement showing accounting of changes to Contract Sum.

4. Advise Owner of pending insurance change-over requirements.

5. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.

6. Obtain and submit releases enabling Owner's full and unrestricted use of the work and access to services and utilities, including (where required) occupancy permits, operating certificates, and similar releases.

7. Deliver tools, spare parts, extra stocks of materials, and similar physical items to Owner.

8. Complete start-up testing of systems, and instructions of Owner's operating/maintenance personnel. Discontinue (or change over) and remove from project site temporary facilities and services, along with construction tools and facilities, mock-ups, and similar elements.

9. Complete final cleaning up requirements, including touch-up painting of marred surfaces.

B. Inspection Procedures: Upon receipt of Contractor's request, Architect/Engineer will either proceed with inspection or advise Contractor of prerequisites not fulfilled. Following initial inspection, Architect/Engineer will either prepare certificate of substantial completion, or advise Contractor of work which must be performed prior to issuance of certificate; and repeat inspection when requested and assured that work has been substantially completed. Results of completed inspection will form initial "punchlist" for final acceptance.

1.4 PREREQUISITES TO FINAL ACCEPTANCE

A. General: Prior to requesting Architect's/Engineer's final inspection for certification of final acceptance and final. payment, as required by General Conditions, complete the following and list known exceptions (if any) in request:

1. Submit final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit updated final statement, accounting for additional (final) changes to Contract Sum.

3. Submit certified copy of Architect's/Engineer's final punch-list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by Architect/Engineer.

4. Submit final meter readings for utilities, measured record of stored fuel, and similar data as of time of substantial completion or when Owner took possession of and responsibility for corresponding elements of the work.

5. Submit consent of surety and waiver of liens.

6. Submit final liquidated damages settlement statement, acceptable to Owner.

7. Revise and submit evidence of final, continuing insurance coverage complying with requirements.

B. Re-inspection Procedure: Upon receipt of Contractor's notice that the work has been completed, including punch list items resulting from earlier inspections, and excepting incomplete items delayed because of acceptable circumstances, Architect/Engineer will re-inspect the work. Upon completion of re-inspection, Architect/Engineer will either prepare certificate of final acceptance or advise

Contractor of work not completed or obligations not fulfilled as required for final acceptance. If necessary, procedure will be repeated.

1.5 RECORD DOCUMENT SUBMITTALS

A. General: Specific requirements for record documents are indicated in individual sections of these specifications. Other requirements are indicated in General Conditions. General submittal requirements are indicated in "submittals" section. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for Architect's/Engineer's reference during normal working hours.

B. Record Drawings: Maintain a white-print set (blue-line or black-line) of contract drawings and shop drawings in clean, undamaged condition, with mark-up of actual installations which vary substantially from the work as originally shown. Mark whichever drawing is most capable of showing "field" condition fully and accurately; however, where shop drawings are used for mark-up, record a cross reference at corresponding location on working drawings. Mark with red erasable pencil and, where feasible, use other colors to distinguish between variations in separate categories of work. Mark-up new information which is recognized to be of importance to Owner, but was for some reason not shown on either contract drawings or shop drawings. Give particular attention to concealed work, which would be difficult to measure and record at later date. Note: relate change order numbers where applicable. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on cover of each set.

C. Record Specifications: Maintain one copy of specifications, including addenda, change orders and similar modifications issued in printed form during construction, and mark-up variations (of substance) in actual work in comparison with text of specifications and modifications as issued. Give particular attention to substitutions, selection of options, and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note related record drawing information and product data, where applicable. Upon completion of mark-up, submit to Architect/Engineer for Owner's records.

D. Maintenance Manual: Organize maintenance-and-operating manual information into suitable sets of manageable size, and bind into individual binders properly identified and indexed (thumb-tabbed). Include emergency instructions, spare parts listing, copies of warranties, wiring diagrams, recommended "turn-around" cycles, inspection procedures, shop drawing, product data, and similar applicable information. Bind each manual of each set in a heavy-duty 2", 3-ring vinyl covered binder, and include pocket folders for folded sheet information. Mark identification on both front and spine of each binder.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. General Operating/Maintenance Instructions: Arrange for each installer of work requiring continuing maintenance or operation, to meet with Owner's personnel, at project site, to provide basic instructions needed for proper operation and maintenance of entire work. Include instructions by manufacturer's representatives where installers are not expert in the required procedures. Review maintenance manuals, record documentation, tools, spare parts and materials, lubricants, fuels, identification system, control sequences, hazards, cleaning and similar procedures and facilities. For operational equipment, demonstrate startup, shutdown, emergency operations, noise and vibration adjustments, safety, economy/efficiency adjustments, energy effectiveness, and similar operations. Review maintenance and operations in relation with applicable warranties, agreements to maintain, bonds, and similar continuing commitments.

3.2 FINAL CLEANING

A. General: Special cleaning for specific units of work is specified in sections of Divisions 2 through 16. General cleaning during progress of work is specified in General Conditions and as temporary services in "Temporary Facilities" section of this Division. Provide final cleaning of the work, at time indicated, consisting of cleaning each surface or unit of work to normal "clean" condition expected for a first-class building cleaning and maintenance program. Comply with manufacturer's instructions for cleaning operations. The following are examples, but not by way of limitation, of cleaning levels required:

1 . Remove labels which are not required as permanent labels.

2. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing substrates which are noticeable as vision obscuring materials. Replace broken glass and damaged transparent materials.

3. Clean exposed exterior and interior hard-surfaced finishes, to a dirt-free condition, free of dust, stains, films and similar noticeable distracting substrate. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective condition.

4. Remove debris and surface dust from limited access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.

5. Vacuum clean carpeted surfaces and similar soft surfaces.

6. Clean project site (yard and grounds), including landscape development areas, of litter and foreign substances. Sweep paved areas to a broom clean condition; remove stains, petro-chemical spills and other foreign

deposits. Rake grounds which are neither planted nor paved, to a smooth, even-textured surface.

7. Lubricant properly and completely all machinery in this contract.

8. The windows furnished for this project are a finished product and shall be treated as such by all trades. The General Contractor shall see that these windows are not mistreated or abused. The masonry and plaster Contractor shall be sure that mortar or plaster spots are not allowed to stay on aluminum surfaces for more than 12 hours. Windows shall not be used as supports for scaffolding or any other purpose that will damage them. The General Contractor shall provide the necessary protection of all windows from misuse or damage during the course of erection and shall clean all plaster, mortar or other foreign materials from the windows after installation and glazing. All glass in windows, exterior and interior, shall be cleaned with glass cleaner.

B. Restoration of Site: At completion of Project and before leaving job site, Contractor shall be responsible for restoring the site to the original state in which he found it at the start of the Project. This will include repair of grass areas used for storage of materials or stockpiling of debris, and repair of any other areas on property which the Contractor has damaged in the course of his work.

C. Removal of Protection: Except as otherwise indicated or requested by Architect/Engineer, remove temporary protection devices and facilities which were installed during course of the work to protect previously completed work during remainder of construction period.

D. Compliances: Comply with safety standards and governing regulations for cleaning operations. Do not bum waste materials at site, or bury debris or excess materials on Owner's property, or discharge volatile or other harmful or dangerous materials into drainage systems; remove waste materials from site and dispose of in a lawful manner.

END OF SECTION

PART 1: GENERAL. The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 GENERAL CONTRACTORS WORK

Remove all foreign materials from lawn and site area.

All pavement and sidewalk areas shall be left broom clean.

1.2 ALL CONTRACTORS

During construction all contractors shall be responsible for removing debris left by his work at frequent intervals in order that no large accumulation of debris be left for any length of time. Each contractor shall remove all tools, scaffolding, waste materials caused by operations under his charge and at completion of job leave his work in cleaned condition satisfactory to the Owner and Architect.

END SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers standard warranties on products and special warranties.

1 . Refer to the General Conditions for terms of the Contractor's period for correction of the Work.

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

1 . Division I Section "Contract Closeout" specifies contract closeout procedures.

2. Divisions 2 through 16 Sections for specific requirements for warranties on products and' installations specified to be warranted.

3. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

C. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 DEFINITIONS

A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1 . Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

A. Submit written warranties to the Architect/Engineer prior to the date certified for Substantial Completion. If the Architect's/Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect/Engineer.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect/Engineer within 15 days of completion of that designated portion of the Work.

B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect/Engineer, for approval prior to final execution.

C. Form of Submittal: At Final Completion compile 2 copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

D. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate

contents, and sized to receive 8 ½" X 11"paper.

1 . Provide tabbed divider for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.

2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES", Project title or name, and name of the Contractor.

3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2: PRODUCTS (Not Applicable)

PART 3: EXECUTION

3.1 LIST OF WARRANTIES

A. Provide warranties on products and installations as specified in Division 2 through 16 Sections.

END OF SECTION

PART 1: GENERAL. The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 REMOVAL

This Section requires the removal and subsequent off-site disposal of the following:

A. Removal of existing roofing as shown on plans.
B. Removal of existing landscaping as shown on plans.
C. Removal of existing windows, doors, and overhead doors as shown on plans
D. Removal of existing systems as shown on plans

1.2 CONDITION OF STRUCTURES

A. The Owner assumes no responsibility for the actual condition of items that are to be removed, replaced, and or repaired. Field verify condition of existing structure prior to start of any work.

1.3 PROTECTIONS

A. Provide temporary barricades and other forms of protection as required to protect the Owner's personnel and general public from injury due to demolition work.

B. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to and from the site.

C. Protect existing site utilities, which are to remain in use.

1.4 DAMAGES

A. Promptly repair all damages caused to adjacent facilities by demolition work at no cost to the Owner.

1.5 TRAFFIC

A. Conduct demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, lawns, and other adjacent occupied or used facilities.

1.6 UTILITY SERVICES

A. Maintain existing utilities indicated to remain. Keep in service and protect against damage during demolition operations.

PART 2: PRODUCTS (Not Applicable)
PART 3: EXECUTION (Not Applicable)

END OF SECTION

SECTION 02200 - SOIL CONDITIONS

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 GENERAL SCOPE OF WORK

A. Complete filling, backfilling, rough grading, finish grading, earth fill, all as required, indicated and specified herein.

B. Excavate under the entire area of the building to the depth required for footings and slabs and such other excavations necessary for the installation of the work shown on the drawings and stated in this specifications for over excavation.

B. All topsoil shall be removed under the building proper.

D. Immediately under the floor slab shall be a 8 inch layer of compacted granular fill.

E. All exterior concrete walk slabs shall have a 6 inch minimum layer of granular material immediately under the slab to aid soil drainage and avoid frost heaving.

F. The bottom of all excavated trenches for footings shall be subjected to a minimum of two passes by a vibratory compactor. Densification of loose granular deposits shall be done in accordance with Section 1.6.

1.2 EXCAVATING

Excavate under the entire area of the building to the depth required for footings and slabs, and such other excavations necessary for the installation of work as shown on the drawings. Soil taken from excavations shall be used for backfill only. Any excess earth shall be removed from the site, or deposited in other locations on the site.

Excavations for walls shall be wide enough to permit the removal of forms, pointing up, etc. and at no point less than 24 inches from the face of the wall. Trenches for footings may be trimmed to exact size of the footings where earth is solid enough to hold it's shape during the placing of the footing.

Excavate to a depth at least 8" below bottom of concrete slabs on fill. All exterior slabs-on-grade shall have at least 8" of compacted granular fill for soil drainage purposes.

If made ground or pockets of soft loam are encountered in bottoms of any footing trenches, the Contractor shall immediately notify the Engineer in order that provisions may be made for carrying footings deeper at such points.

Excavations shall be properly shored and braced where necessary to prevent caving in and the Contractor shall do all necessary bailing or pumping required to keep the excavations free from water.

Any sewers, pipes, or conduits in active use, encountered during excavation are to be properly diverted, so as not to interfere with the construction, and are to be left in a working condition. Sewers, pipes, or conduits that have been abandoned, shall be cut off outside building line and securely plugged at ends. If such are encountered in course of excavation, it shall be the contractors duty to ascertain from the proper authorities whether they are in active use or have been abandoned, before proceeding as above specified.

Any piping, conduits, etc. encountered in excavating, unless required to be removed, shall be temporarily supported and maintained until permanent support has been restored. (See Mechanical - Division 15)

1.3 TESTING

The General Contractor shall include in his bid the cost associated to have a soil testing company provide soil testing on this project. Field density testing to be performed in accordance with ASTM D6938, nuclear gauge method, or ASTM 1566, sand cone method. The frequency of the testing should produce a minimum of one (1) field density rest result per 2,500 square feet, per material lift, and as necessary to adequately represent the area and compaction effort.

1.4 FILLING AND BACKFILLING

After forms are removed and water proofing applied where necessary and allowed to dry, fill between exterior walls, and earth banks with earth removed from excavation of course pit run gravel to a point 24" below finish grade line.

Filling shall be placed in layers of about 8" carefully tamped and flooded. Under no circumstances shall rubbish or debris from the building be used for backfilling or grading. Compaction as stated in Section 1.6 for each layer.

If fill is to be provided on both sides of walls, fill on both sides at same time. When filling around piers, fill in equal layers around perimeter.

1.5 GRADINGS

Finish grades indicated on the drawings are finished topsoil elevations. Rough grading shall be done to within one foot of these elevations and shall consist of evenly grading the site to one foot below the finish grade contours, with clean earth fill removed from excavation or brought to site from other source, ready for topsoiling operations. Rough grading to slope away from walls to provide water shed. Take care during grading operations to protect all constructed items and repair if they are damaged.

1.6 SITE SOIL PREPARATION

In order to insure that the footing foundation system is founded on well compacted soil and the floor system is founded on well compacted soil, densification of loose granular deposits is to be undertaken by mechanical compaction in accordance with the following procedure:

A. The bottom surface of the excavation is to be subjected to systematic compaction by means of a vibratory compactor. The compaction operations are to be continued until the material immediately below the bottom of the excavation has been compacted to a minimum of 100% of maximum density as determined in accordance with American Society for Testing and Materials D-698, Method "A" or Method "C" which ever is applicable.
No fewer than 6 passes are to be made in any event.

B. Subsequent to, the bottom of the excavation compaction, systematic backfill operations are to be carried out on a lift-by-lift basis, employing clean granular material. Compaction of individual lifts is to be carried out by the previously referenced vibratory compaction device and material density within the backfill structure is to be verified at a minimum of 100% of maximum density. Backfill operations are to be carried to underside of floor slab.

For general area improvements such as pavements, drives, etc., the materials existing from subgrade elevation to minus 12 inches, must be compacted to exhibit an in-place density of not less than 95 percent of maximum density as determined in accordance with the requirements of American Society for Testing and Materials D-698, Method "A" or Method "C" whichever is applicable. Normal stripping operations of sod and vegetation shall supersede fill and compaction.

The General Contractor shall keep a log showing how many passes the compactor has made each day and the location in which this compaction took place. The log shall further show the location of all density tests and proctor tests. At the end of each working day, the log shall be filled out and a copy sent to the Structural Engineer.

1.7 FINISH GRADING

Finish grading, minimum depth 12" shall be done with top soil material stripped from site during preliminary work and stockpiled for this use or shall be clean top soil obtained from other source and hauled to site. Top soil shall be spread and rolled to the contours indicated and to satisfaction of the Engineer ready for seeding as specified.

PART 2: PRODUCTS (Not Applicable)

PART 3: EXECUTION (Not Applicable)

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Include all form work of any and all types and kinds, both temporary and permanent, as noted or indicated on drawings, specified herein or required to contain concrete during it's curing period even though such forms may or may not be specifically called out or noted.

Forms for all reinforced concrete work shall be wood or metal.

1.2 DESIGN OF FORMS

Design and construction of safe and adequate forms, shores, diagonal bracing and foundation form work shall be the responsibility of the Contractor. In addition, the design of all form work shall be in accordance with recommendations of "ACI" Standard Recommended Practice for Concrete Form Work ACI-347. These recommendations shall serve as a minimum standard of design for all form work.

Forms shall be constructed to the shape, lines, grades and dimensions indicated or noted on drawings and shall be so maintained during the placing operation that when forms are removed the concrete work will be perfectly cast as intended by the Drawings with a maximum tolerance in either the vertical or Horizontal place of 1/4" in 10 feet.

Forms shall be so designed and constructed that they may be removed without injury to the concrete.

PART 2: PRODUCTS

2.1 MATERIAL

For concrete exposed to view in the finished structure, forms shall be 5/8" or 3/4" 5-ply Douglas fir structural plywood of concrete form grade meeting the Bureau of Standards Commercial Standard CS-45 if the forms are unlined. 1/4" Douglas fir plywood of concrete form grade and 3/16" Masonite Presdwood shall be used for lined forms. Presdwood shall be thoroughly wet with water on the screen side at least 12 hours before use.

For exposed concrete form material may be selected at the Contractor's option provided it meets the requirements set out under "Form Construction".

2.2 FORM COATING

For exposed concrete shall be A.JC. Horn Company "Form Film", "Chem-Masters Corporation, Creteban 30", Toch Brothers, Inc., "Form Coating", Sonneborn Building Products "Formsaver" or "as approved equal".

2.3 FORM TIES, INSERTS, ETC

Metal form ties shall be used for all wall forms and shall be Richmond Screw Anchor Co., Inc., "Snap-Tys" Type SBR or of a type approved by the Engineer. They shall be adjustable and act as a spreader and tie also. When ties are removed or broken off, no metal shall be left closer than one (1) inch from the surface of the wall. Form ties shall not be placed in exterior walls above finished grade. Wood separators and wire ties will not be acceptable.

Provide and install metal key slots in the face of any concrete work where brick facing or partitions occur and provide necessary number of keys for anchoring masonry thereto. Slots shall be 18" o.c. for masonry facing.

No pipes or sleeves of any size shall be placed through beams, columns or slabs; other than those located on drawings, without prior approval from the Engineer.

If built-in items, not detailed or noted on drawings are required, this Contractor shall see that they are provided by the trades involved and built-in.

Mechanical and Electrical Contractors shall furnish and set inserts incidental to their work. Concrete subcontractor shall keep them informed as to the progress of the work in order that the setting of their inserts, sleeves, piping, etc., may be timed to cause the least delay to the work.

Install inserts, weld plates, bolts, and other accessories as indicated, noted or detailed on drawings, specified, or noted on shop drawings.

PART 3: EXECUTION

3.1 CONSTRUCTION OF FORMS

Wood forms for floor slabs shall be straight and true. Bottom edges of all joints, beams, girders, and exposed edges of all columns shall be chamfered. Saw marks shall be removed from face of chamfer strips. Forms for beam and girder sides and slabs of suspended floor construction shall be of new plywood or used plywood approved by the Engineer and may be re-used only after they have been cleaned and approved.

Edges of vertical columns abutting concrete walls, and exposed interior wall, columns and beam surfaces shall be lined with nonabsorbent smooth-faced board, or constructed of plywood, applied in maximum sized sheets with all joints neatly fitted.

Forms shall be built mortar-tight and shall be maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

Where shoring supporting forms rest on the ground, some means shall be provided for detecting and deflection of the forms while concrete is being placed. The Engineer may require the Contractor to employ screw jacks which the Contractor shall have on hand or hardwood wedges to take up any settlement in the false-work either before or during the placing of concrete.

All forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. The forms shall be securely tied together by approved means and braced in a substantial and unyielding manner and so designed and built that the finished concrete will conform to the proper dimensions and contours, with a maximum tolerance in either the vertical or horizontal plane of 1/4" in 10 feet.

All dust, sawdust, shavings, and other debris, shall be removed from within the forms before concreting begins. For narrow walls where the bottom of the forms is inaccessible, the lower form boards shall be left loose on the back side so that they may be removed for cleaning out extraneous material, immediately before placing the concrete.

The interior of the forms shall be treated with coatings specified herein before, placing the concrete to insure non-adhesion of the mortar. Angles of the forms shall be slightly sprayed in order that they may be readily removed without injury to the concrete.

The foregoing specifications for "Forms" as regards design, mortartightness, fillet corners, leveled projections, bracing alignment, removal, reuse and coating, shall apply with equal force to metal forms. If metal forms are used, they shall be new. The metal used for forms shall be of such thickness that the forms will remain true to shape. All bolts and rivet heads shall be countersunk. Clamps, pins or other connecting devices, shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or line up properly shall not be used. Special care shall be exercised to keep metal forms free from ruse, grease, or other foreign matter which will discolor the concrete.

All shores supporting any concrete bridging, joints and beams, shall remain in place at least 15 days after placing of concrete.

3.2 WORK IN FORMS

After forms have been placed and approved, the Contractor shall see that all mechanics have been properly notified and are given sufficient time to complete the installation of their work. Placing of reinforcing steel shall proceed progressively with the work of the other mechanics and each shall arrange his working schedules so as to avoid disturbing or moving already installed by one trade to admit the work of another. Each trade shall be entirely responsible for the proper installation and securing of the work and each shall keep his work under observation during placing of the concrete.

3.3 FORMS REMOVAL

Forms shall remain in place for periods which will be determined as hereinafter specified or as directed by the Engineer.

All shores supporting any concrete bridging, joists, and beams, shall remain in place at least 15 days after placing of concrete.

No shores shall be removed without the express permission of the Engineer. The Engineer may require shores to be left in place for longer periods depending upon the temperature to which the concrete is subjected during the period of curing and upon the construction loads to be applied to the concrete after this 15 day period. Joist forms shall be so constructed that the forms can be removed without disturbing the shores under the bridging joist. Beam bottoms shall remain in place until shoring is removed. Joists shall be reshored between the beams and bridging joists immediately after the removal of the joist forms. Additional shores shall be placed under any points of concentrated loading. In warm weather, forms may be removed from walls in not less than 36 hours, and from any joists, sides of beams and columns in not less than 3 days. Removal of forms and shoring shall in any case be at the risk of the Contractor, but the Engineer may at any time refuse to permit their removal if in his judgment there might be resulting damage to the structure.

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Furnish all concrete reinforcing steel, welded wire mesh and necessary related items indicated, noted or detailed on drawings and specified herein.

1.2 SHOP DRAWINGS

Provide complete reinforcing steel shop drawings to the Engineer for this approval in accordance with paragraph "SHOP DRAWINGS" on the General Conditions and Supplemental General Conditions.

Shop drawings shall be prepared in strict accordance with the requirements of the current edition of the Manual of Standard Practice for Detailing Reinforced Concrete Structure as published by the American Concrete Institute, ACI-315.

PART 2: PRODUCTS

2.1 STEEL

In general, reinforcing rods for concrete work shall have the size, position and number shown on the structural drawings.

All reinforcing steel shall conform to ASTM A-615-68. Steel for stirrups and column ties shall be Grade 40. All steel for main reinforcing shall be Grade 60.

2.2 WIRE MESH

Where wire mesh is indicated for reinforcing, it shall be of size and gauge as shown on the drawings, and shall be made of best quality drawn steel wire, woven mechanically of electrically welded to form the mesh. ASTM A-185-70. All sidewalks and stoops shall have 6x6 10/10 unless noted otherwise.

2.3 FABRICATION

All fabrication, including bending shall be done at the mill or in the shop. No field bending will be permitted. All pieces shall be labeled and like pieces shall be bundled together.

All stirrups groups shall be wired in units convenient for handling and stable in forms.

PART 3: EXECUTION

3.1 PLACEMENT

All steel shall be free from flaky rust, grease, dirt, scale, or paint. All reinforcement shall be held in position by suitable metal devices which shall insure accurate spacing both horizontally and vertically.

Where not otherwise indicated, bars in foundations and retaining walls shall be placed so that extreme face of steel is not less than 3" from exterior face of concrete.

Concrete cover for reinforcing bars not shown in standard details or on other details throughout the drawings shall conform to the minimum requirements of the ACI Code, latest edition.

The Engineer shall be notified by the Contractor when steel placement for a concrete pour is nearing completion so that the work may be inspected. Sufficient time shall be allowed for the steel setter to make any necessary corrections so that all reinforcement, correct in quantity, size and position, will be wired in place when concreting is started.

Bars shall be in long lengths and splicing shall be made in an approved manner, lapped not less than 30 diameters, unless otherwise indicated, but no splice shall be located at point of maximum stress. Bars of 18S size in foundations may be spliced using a mechanical tension butt splicing unit such as Cadweld "T" Series, meeting ACI Code Requirements 318-63 Section 805(b) and 805(d).
Steel must contain proper weld ability properties.

Reinforcing steel in slabs on earth shall be supported on metal rods or by concrete blocks not readily overturned.

All reinforcing steel shall be accurately located in the forms and firmly held in place before and during the placing of the concrete by means of supports adequate to prevent displacement during construction and to keep the steel at proper distance from the form.

Reinforcement shall have 3/4" of concrete covering in slabs and not less than 1-1/2" in beams unless otherwise specifically indicated on the drawings.

All rods shall be securely wired at intersection with No. 16 gauge annealed lacing wire. Reinforcing rods shall be bent or hooked as required, or as indicated by the drawings and shall be spliced only where necessary. All splices of rods shall be securely wired in a satisfactory manner.

Mesh reinforcement shall be well lapped at least 6" at ends and edges wired together at joints and supported on chairs as required for rods wherever conditions will admit of so doing.

END OF SECTION

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1: GENERAL

The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Provide all concrete and necessary related work indicated, noted or detailed on the drawings and specified herein.

1.2 STANDARD SPECIFICATIONS

The ACI publication, "Standards and Code Requirements for Concrete and Reinforced Concrete", latest edition, shall govern all concrete work for this project except where otherwise specified herein.

PART 2: PRODUCTS

2.1 MATERIALS AND STORAGE

All materials, unless otherwise indicated, noted or specified, shall conform to the latest edition of the standard specification of the American Society for Testing Materials covering the materials being used.

2.2 CEMENT

Cement shall be an approved blend of Portland Cement of a standard brand and subject to tests hereinafter specified. All cement shall be protected from the weather and from dampness. No cement shall be used which has absorbed sufficient moisture to become lumpy when dry. The cement used shall meet the requirements of standard specifications for Portland Cement adopted by ASTM, seal designation C-150-71, and each shipment shall be accompanied by a certificate of test which shall be kept on file by the Contractor.

2.3 AGGREGATE

All aggregate shall be washed gravel, clean and free from loose soft stone, vegetable matter, or other ingredients which would affect the strength of the concrete. ASTM C-33.

2.4 SAND

Sand shall be thoroughly washed and shall be free from loam, soft stone, or other ingredients which would affect the strength of concrete. Sand shall be well graded from coarse to fine with coarse particles predominating, but containing no grains which will not pass through a 1/4" mesh. ASTM C-33.

2.5 GRAVEL

Gravel for non-reinforced concrete shall be 1/4 to 1-1/2" in size and gravel for reinforced concrete shall be uniformly graded from 1/4" to 1" in size unless otherwise specified. ASTM C-33.

2.6 WATER

Water used shall be fresh, clean and fit to drink, free from oil, acid, alkali, salts or organic matter.

2.7 METHODS

The methods used in piling and handling aggregates shall be such that the fine and coarse aggregates shall be kept separate prior to their placing into the mixer. They shall be kept clean and free from foreign substances. No aggregates shall be used in the work which has not been stored on the project site for at least twenty-four hours.

Aggregates shall be stored so as to insure the preservation of their quality and fitness for the work. When considered necessary by the Engineer, they shall be placed on wooden platforms or other hard, clean surfaces and not on the ground, and shall be located so as to facilitate proper inspection.

No bank run gravel will be permitted on the work except for certain fill.

Air entraining agent shall be a neutralized vinsol resin type furnished in a water formulated solution meeting the requirements of ASTM C-260.

The use of hydrated lime or other admixtures to increase the fluidity, density, or to hasten the seasoning of the concrete will not be permitted unless approved by the Engineer.

Floor slab to receive curing/sealing/hardener compound. The product to be used shall be "Burke 1101 Acrylic Cure/Seal/Hardener", or equal on all floors and exterior concrete slabs-on-grade. Provide submittals for approval on the curing/sealing/hardener compound.

2.7 DESIGN OF MIX

The concrete mix shall be proportioned and designed to develop a minimum ultimate compressive strength of 3000 psi and 4000 psi at 28 days and shall be such as to produce concrete that will work readily into the corners and angles of the form and around the reinforcement without excessive spading and without permitting the materials to segregate or free water to collect on the surface.

A minimum of 5 sacks of cement per yard shall be used for 3000 psi concrete, 6 for 4000 psi concrete. All footing concrete shall be Fc'=3,000 psi. All concrete above the footings, slabs on grade, and floor slabs shall be Fc'=4,000 psi.

No more than 6-1/2 gallons of water per sack (94# cement) shall be used per batch. The water content of the concrete shall be the least that will produce uniformly dense concrete free from aggregate pockets or honeycombs.

Corrections shall be made for the amount of moisture contained in the aggregates and allowances shall be made for absorption of moisture by the aggregates during the period of mixing and handling.

The water-cement ratio, including free water in aggregate, shall not exceed that approved by the Engineer. Variations and corrections in slump shall be made by correcting the proportions and amount of aggregates used.

Cement mortar for topping and grouting shall be mixed in the proportions of one part cement to not more than two parts, clean, fine sand, unless otherwise noted.

The proportions herein specified for mixing of concrete shall not be varied except as may be found necessary to meet the test requirements herein specified and then only on the instructions of the Engineer.

All concrete exposed to weather, except slabs and flat work which are to receive trowel finish, shall be air-entrained with air content controlled at 5% +/- 1%, by volume.

Steel stair treads and platforms and certain areas, where indicated on the drawings, shall receive a fill of thickness indicated, composed of 1 part Portland Cement, 2-1/4 parts sand and not more than 3-1/2 parts pea gravel, struck off and steel trowelled to a smooth dense surface, using only such amount of dry mixture of 2 parts cement to 3 parts sand as necessary to prove workable.

Materials for concrete shall be measured separately by weight; proper provision shall be made, as approved by the Engineer for measuring of materials and water used in each batch.

2.9 MIXING

A. PLANT MIX CONCRETE. If plant mix or mixed-in-transit concrete is used, each shipment shall be accompanied by duplicate certificates, showing analysis of the mix. It shall be produced in conformance with the standard specifications for "Ready Mixed Concrete" Serial Designation C94 of the American Society for Testing Materials within the limitations of materials composition, consistency, quality, inspecting and testing as provided therein.

B. JOB MIX CONCRETE. If concrete is prepared at the site, it shall be mixed in a standard type of mechanical batch mixer that mixes one complete batch at a time, which is entirely discharged before another is introduced.

The concrete shall be mixed to the desired consistency and until the mass is uniform in color and homogeneous.

The mixing shall continue for at least one (1) minute after all ingredients are in the mixer.

During the period of mixing, the drum shall operate at the speed for which it was designed, except that peripheral speed of the drum shall not be less than 175 nor more than 225 foot per minute.

If this procedure does not effect a thorough mixing of the concrete, an additional number of turns at the same rate of speed shall be given until a thorough mixing of each batch of concrete is secured. The entire contents of the mixer shall be removed from the drum before material for the succeeding batch is placed therein and the mixer shall preferably be equipped with mechanical means for preventing the addition of aggregate or water after mixing has commenced.

The mixer shall be equipped with adequate water storage and a calibrated measuring device for accurately measuring the amount of water used in each batch. The mixer shall be equipped with a batch meter for accurately recording the time of mixing of each batch and also an attachment for automatically locking the discharge chute so as to prevent the emptying of the mixer until the materials have been mixed with the specified minimum time. No mixer shall be operated above it's rate capacity, or be used which has a rated capacity of less than one (1) sack batch, and batches requiring a fractional sack of cement shall not be mixed unless the cement is batched by weight.

The first batch of concrete materials placed in the mixer shall contain an additional quantity of cement, sand and water, sufficient to coat the inside surface of the drum without diminishing the mortar cement of the mix. Upon the cessation of mixing for any considerable length of time, the mixer shall be thoroughly cleaned.

Care shall be taken to secure the exact proportions at all times. The mixed concrete shall be, as stated hereinbefore, of plastic consistency that will flow into the form of trenches and about reinforcement where used for any reinforced work, but shall not be so wet as to cause separation of materials.

Concrete shall be mixed only as required for immediate use and shall be conveyed directly from the mixer and deposited in place. Concrete in which the initial set has occurred shall not be used.

A competent foreman shall be in attendance at the mixer to give account of each batch, which leaves the mixer.

PART 3: EXECUTION

3.1 PLACEMENT OF CONCRETE

Proper provisions shall be made before the concrete is placed to embed all inserts, including inserts to be provided by others.

It will be each subcontractor's responsibility to provide the Contractor with information regarding openings or chases he will require in the concrete work and to provide all his items which will be cast into, embedded in or will otherwise be monolithic with the concrete pour. The Contractor, prior to placing any concrete, shall give written notice to the Engineer and all subcontractors of his intention to place concrete and his schedule of placing.

Provide concrete curbs, sills, bases, etc. as detailed on drawings.

No concrete shall be placed until after the bearing soil has been inspected and approved by the Engineer. Concrete shall not be placed upon frozen ground. Dry soil shall be thoroughly dampened except in freezing weather or as otherwise directed. Forms shall be thoroughly cleaned out, wetted, oiled, or lacquered before concrete is placed.

No concrete shall be placed until the Engineer has inspected and approved the forms and placing of reinforcement. After inspection and approval of forms and reinforcements, Contractor shall proceed with the placing of concrete. All slabs shall be filled to the top surface in one continuous operation. If possible, the placing of concrete shall be carried on as a continuous operation until the completion of the section. If for any reason, placing of concrete has to be stopped before the completion of the part being poured, greatest care must be exercised to stop at a point where the joint will not weaken the construction. Such joint shall be at the point of minimum shear stress in the concrete.

The maximum pour for slabs shall be as noted in General Notes on the drawings.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs and chutes for conveying concrete from the mixer to the forms shall be permitted only on authorization of the Engineer.

All chutes, troughs, etc. shall be kept clean and free from coatings of hardened concrete by flushing with water after each run; water used for flushing shall be discharged clear of the concrete already in place.

Concrete shall not be permitted to drop freely more than five (5) feet and it will not be permissible to allow concrete to run or be taken to fill each part of the form by depositing the concrete as near final position as possible. The coarse aggregates shall be worked back from the forms and the concrete forced around the reinforcement without displacing bars. Concrete shall not be permitted to flow under runways or other obstructions that makes spading impossible.

Concrete shall be spaded and puddled with proper tools into compact, homogeneous mass.

The concrete shall be placed as rapidly, continuously and in as large areas as possible, or until the unit of operation as previously approved has been compacted. In any given operation the batches shall be placed that each shall be installed and compacted before the preceding one has taken it's initial set, so that perfect joining will be effected without marked indication on the finished faces of the concrete.

The Contractor shall keep a capable mechanic on the job during the placement of concrete to keep reinforcement in proper alignment and spacing.

Insert asphalt strips of sufficient width against all masonry where cement work is installed, to protect masonry while concrete is being placed.

3.2 MECHANICAL VIBRATION

The concrete shall be compacted by means of mechanical vibrator operated within the mass of concrete.

Vibration shall be supplemented by hand spading. The concrete shall be spaded by hand in all corners and angles of the forms and along all form faces as elsewhere herein specified. The concrete shall be vibrated with a frequency of not less than 7000 impulses per minute, the vibration shall be of sufficient intensity and duration to cause flow or settlement into place and complete compaction. Care must be exercised that concrete is not over-vibrated, particularly if it is of a relatively wet consistency exceeding 4" in slump and that vibrators are not used to transport concrete in the forms. Vibrators should be inserted and withdrawn at many points from18" to 30" apart for short periods, usually from 5 to 15 seconds is sufficient, in preference to insertion for longer periods at wider intervals. Systematic spacing of insertions of the vibrator should be established to insure that no concrete is missed. Vibration shall be applied to the mass at the point of deposit and in the body of freshly deposited concrete.

The mechanical vibrator shall be of a type and design approved by the Engineer. It shall be adequately powered and capable of transmitting vibrations of the required frequency to the concrete.

The vibrator shall be applied to the concrete immediately after deposit and so manipulated that the concrete is reduced to a uniform plastic mass thoroughly compacted. It shall be thoroughly compacted around the reinforcement and worked into the corners and angles of the forms. The vibrators shall not be attached to the forms or the reinforcement nor shall it be placed on reinforcing steel.

Concrete shall be placed in layers of uniform thickness and the apparatus so operated that the vibrating element does not penetrate through the layers of fresh concrete and disturb partially hardened concrete in lower layers. Vibrators shall not be pushed into the mass of concrete too rapidly and should be withdrawn slowly.

3.3 TESTS

During the progress of the work, the general contractor shall make test cylinders from the run of the concrete mixer. These test cylinders shall be made in strict compliance with ASTM C-31 latest revision. All testing shall be included in the General Contractors bid for this project.
Four cylinders shall constitute a set of test cylinders. Separate tests will be required from each concrete pour for footings, walls, columns, and two sets from pours for concrete floor slabs in each story including roof.
These tests shall be made on 6" x 12" concrete cylinders loaded in compression at 7, 14, and 28 days.

Fourth cylinder is to be kept as a spare. The Contractor shall cooperate in every way that in the end concrete of the desired quality be obtained.

All concrete shall contain the minimum properties of strength.

Air content of fresh concrete shall be determined according to ASTM designation C-231, latest edition. Test for air content shall be made at the point of delivery.

Slump tests made in accordance with ASTM C-143, latest revision, shall be made by the Contractor from the run of the mixer. The average slump of these samples shall constitute a test. The maximum average slump for footings and floors placed on ground shall not exceed 3 inches, and for reinforced work shall not exceed 5 inches. Should any set of samples show greater slump than hereinbefore specified, the proportions of the mix shall be varied until the proper slump is obtained, but under no conditions shall the amount of water specified per sack of cement be increased. Contractor shall provide hollow metal cones for making slump tests.

If for any reason, in the opinion of the Engineer, the testing of any section of the completed reinforced concrete structure is necessary, a superimposed load shall be applied by the Contractor and the test conducted in accordance with the current Building Rules and Regulations of the State of Indiana. In cases where failure is declared, the Engineer shall have the authority to order the defective construction removed. All expense of removing such defective construction and substituting new construction, including expense of removing and replacing the work of others, or protecting and repairing the work of others shall be borne by the Contractor.

3.4 JOINTS

Provide and install 1/2" expansion strips at edges of concrete slabs and floors around all columns and elsewhere where noted or specified.

Expansion joint material for these locations shall be preformed, non-extruding.

Provide and install expansion joints in exterior slabs where noted. These joints shall be between poured in place concrete top slabs and walls and wherever shown, shall be as detailed. This detail shall also apply at all waterproof slabs.

Control joints as detailed shall be provided where noted on drawings.

3.5 CONCRETE FINISHES

GENERAL The surfaces of all concrete shall be thoroughly worked during the operation of placing by spading as hereinbefore specified. The working shall be such as to force all coarse aggregate from the surface and thoroughly work the mortar against the forms to produce a smooth finish free from water and air pockets or honeycomb. All concrete surfaces shall be true and even, free from honeycombing stone pockets and excessive depressions, projections or air pockets.

FINISHING WALLS All interior exposed concrete shall have all fins and projections removed and the rough surface produced by this operation shall be rubbed smooth. All depressions shall be filled with mortar of the same proportions as the mortar used in the body of the concrete and this mortar shall be smoothed with a wooden float. This work shall be done closely following removal of the forms. All exposed surfaces in finished and unfinished rooms shall be left clean and smooth and shall present a neat and finished appearance.

Concrete which has a total area of honeycombed surfaces in excess of one (1) percent of the total surface area of the forms used for any member of the pour in which the honeycombing is present will not be accepted and must be entirely removed and new concrete substituted by the Contractor at his own expense. Work of other Contractors adjacent to or incorporated in the concrete to be removed shall be removed, and replaced, protected, and repaired to the satisfaction of the Engineer at the General Contractor's expense.

Honeycomb surfaces, for the purpose of enforcing this specification, are hereby defined as the concrete surfaces, next to forms, in which there are voids between the particles of coarse aggregate.

The small amount of honeycomb permitted to remain shall be filled with mortar of the same consistency as the mortar used in the body of the concrete and smoothed with a wooden float, closely following removal of forms. The Engineer shall stop the removal of forms unless the requirements of this section are carried out. Tops of walls shall be floated smooth. The Contractor shall also perform any other operations in addition to those specified herein that may be required to produce the results specified.

All exterior exposed walls shall be given the following treatment: Prepare a grout of about the proportions of one part cement to one part fine sand. Grout shall be of the consistency that will permit it's application to vertical surfaces with a stiff bristle brush.

The grout shall be brushed and floated on the previously dampened surfaces to fill completely all air bubbles and indentations in the concrete. Allow grout to remain on wall until the cement has partially set, then remove excess grout with a steel trowel. After drying for an hour or longer, depending on weather conditions, rub the wall vigorously with burlap to completely clean the grout from the surface leaving pits filled, but there shall not be a visible film of grout on the surface. To lighten up the surface, replace part of the grey cement with approximately 30% of white cement. Rubbing up a lather with a carborundum stone shall not be permitted.

FINISHING FLOORS Immediately following the pour, the concrete shall be screeded off to bring the top surface to proper contour and elevations. Floors, unless otherwise noted, shall be held perfectly level. Where drains occur or slope is indicated, they shall be pitched toward drains or in direction indicated on drawings.

Soon after screeding and while the concrete is still plastic, the surface shall be floated with wood or metal floats and brought to a true grade.

Floor shall be steel trowelled to a smooth and perfect surface after the concrete has hardened enough so that water and fine material are not worked to the surface.

Do not trowel while concrete is too soft or plastic, as this will result in a less wear-resistant surface.

No walking or wheeling shall be permitted on the concrete floors until concrete is thoroughly set.

Floors shall be protected until final completion of the job. Any rough places which develop shall be machine ground before any covering is applied.

Excess water shall be screeded off and the surfaces left clean and level.

In placing depressed slabs, forms shall be provided for forming the edges of depressed sections. These shall be accurately placed with breaks located as directed.

FINISHING EXTERIOR WORK Drive and walks shall have a broom finish which shall be done after the concrete is hard enough so that it will retain the scoring.

Concrete steps, concrete platforms, etc. shall be finished in the following manner.

As soon as water has risen to the surface of treads, it shall be brushed off and the surface sprinkled with dry cement approximately 1/16" thick, over which apply 1/2" of cement mortar topping trowelled to a smooth and perfect surface. As soon as concrete has set sufficiently to be firm, remove the forms from the riser and steps, and remove all fins, ridges, etc. from the surface.

Treads of all concrete steps which do not receive a covering shall have 1/4 lbs. sq. ft. non-ferrous abrasive material, as hereinbefore specified, trowelled into top coat to prevent surface from becoming slippery. In final trowelling do not buy the grit.

3.7 FLOOR HARDNER

Where schedule of interior finish indicates hardened concrete floors, material to be used shall be non-metallic hardner as specified hereinbefore, applied in strict accordance with manufacturers instructions.

3.8 CURING CONCRETE

Concrete surfaces exposed to conditions causing premature drying shall be protected within twenty-four (24) hours of placing. Horizontal surfaces shall be protected by covering with canvas, burlap, sand or other satisfactory material and shall be kept moist. Curing shall continue for a period of not less than five (5) days after placing the concrete, unless otherwise directed by the Engineer. Other precautions to insure the development of strength shall be as specified hereinbefore applied in strict accordance with manufacturers instructions.

3.9 CONCRETE PROTECTION IN COLD AND HOT WEATHER

Recommended Practice for hot weather concreting (ACI 305) Recommended Practice for winter concreting (ACI 306) Where temperature is below 40 degrees F. all water and aggregate used in concrete, shall be heated to a sufficient temperature to make the concrete not less than 60 degrees F. when deposited in place.

Ice and hoar frost shall be removed from the forms with steam jet immediately before concrete is placed. Gauging water shall be heated by a steam jet discharging directly into the water. Aggregate shall be heated by steam pipes properly placed under the aggregate in such manner as to distribute heat throughout the mass. Other methods of heating and aggregate shall not be used unless approved by the Engineer.

The use of salt or other chemicals to accelerate the hardening of concrete will not be permitted under any circumstances.

When, in the opinion of the Engineer, it is necessary, the foundation material on which the footing is to rest shall be protected from freezing.

Immediately after a pour is completed, the freshly poured concrete shall be housed in with tarpaulins or by lumber housing and the air within the enclosure shall be kept at a temperature above 70 degrees F. for a period of seventy-two (72) hours. If for any reason this temperature is not maintained the aging period shall be extended.

The Contractor shall supply such heating apparatus as stoves, salmanders or steam equipment and the necessary fuel. When dry heat is used, means of maintaining atmospheric moisture shall be provided. The aggregates may be heated by either steam or dry heat. The Contractor will be required to keep a watchman on the job at all times during the heating period to insure the maintenances of the proper temperature around the concrete and to see that the concrete is not damaged by fire.

Any concrete placed when the air temperature is at or below 35 degrees F., will be at the Contractor's risk and if such concrete becomes frozen or is inferior in any respect, it shall be removed and replaced at the Contractor's expense.

END OF SECITON

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Provide and install all structural steel and iron, lintels, beams, columns, angles, and miscellaneous structural work of sizes indicated, and assembled as shown or required with all necessary bolts, bearings plates, splice plates, connection angles, etc. Except where specified otherwise, work of this Section shall conform to "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", of the American Institute of Steel Construction and the 9th Edition of AISC “Manual of Steel Construction.”

1.2 SHOP DRAWINGS

Shop drawings shall be furnished to the Architect for all structural steel work and no steel work is to be assembled until shop drawings have been approved and returned.

Complete sets of structural steel drawings, in quantity as noted hereinbefore, with all final corrections and changes shown shall be furnished the Architect for future reference.

PART 2: MATERIALS

2.1 STRUCTURAL STEEL

All steel mentioned above is to meet the requirements of the specifications for steel structures as adopted by the ASTM designation A-992-50, except where noted otherwise on drawings.

All steel is to be assembled at the shops so far as possible.

All steel beams, supported on walls or other masonry, shall be provided with standards steel bearing plates. All bearing surfaces shall be milled.

Provide steel lintels over all masonry openings not using lintel blocks, steel shelf angle, steel channel door frames, base plates, etc. as required or as indicated.

2.2 BOLTS, ANCHORS AND HANGERS

The contractor shall furnish any anchors, bolts, hanger rods, erection bracing, etc. for the work in all of it's parts, even though same may not be herein especially described or mentioned. Bolts shall meet ASTM A-325. Anchor bolts shall be ASTM A-307.

2.3 WELDING

All welding shall be E70XX in compliance with the AWS Code. Welders shall be AWS qualified and hold a current valid certificate.

All welding shall conform to the American Welding Society Code and AISC specifications. Stress in fillet, plug, and shot welds, tension stress transverse to the axis of partial penetration groove welds and shear in such welds when made with A233 Class E70 Series electrodes or by submerged arc Welding Grade SAW-2 on A36, A242 and A441 steels shall be 15800 PSI. Welding shall be by the electric

arc welding process and welders shall be certified by the inspection and testing service as a part of their work. This shall apply to shop and field welding where necessary.

After erection touch up all mars and welding burns in shop coat with specified shop coat materials.

2.4 FABRICATION

Fabricate in accordance with the AISC "Specification for Design, Fabrication and Erection of Structural Steel for Buildings".

Provide holes and connections required for other work. Obtain necessary drawings and templates showing exact location and details required.

Install anchor studs and shear connector studs using manufacturer approved equipment and in accordance with the manufacturer's instructions.

Furnish anchor plates for steel joists.

Furnish all angles required for framing openings in the decks.
Coordinate the quantities, sizes and locations with the Sections involved.

2.5 SHOP PAINT

All steel and iron shall be thoroughly freed of all loose mill scale rust, dirt, grease, or other extraneous substances, and where there is not more than a fine surface or rust, such rusty parts shall first be subjected to the flame of a torch until the oxide has been entirely removed.

After cleaning, the work shall immediately be given a shop prime coat of No. 99 Red Metal Primer by TNEMEC CO., Inc., North Kansas City, or equal, or Fed. Spec. TT-P-636, (Red Oxide).
Paint at a spreading rate specified the manufacturer.

All abutting surfaces of compression members and tops of all milled or turned surfaces are to be immediately protected after such milling or turning, with a coat of white lead or tallow.

All paint must be applied smoothly and evenly and care taken to see that all joints and crevices are properly coated. In built-up work all surfaces to be jointed also drill holes, permanent bolts, etc., shall first be primed and such prime coat shall be allowed to become dry before the several parts are joined. All abrasion of the prime coat use to loading, handling, and erection shall be carefully re-coated as specified.

PART 3: EXECUTION

3.1 ERECTION

Erect all structural steel shown on the drawings or herein specified. The work shall conform to all applicable requirements of the latest standard "Specification for Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.

Provide all tools, scaffolding, hoisting apparatus, bracing, etc., required for the erection of this work, and all bolts for temporary connections. The Contractor shall be held responsible for the safety of all his scaffolding and hoisting apparatus. Conform to OSHA and IOSHA standards.

As a part of the work, base and bearing plates shall be set and leveled to exact elevation for grouting. Base plates shall have necessary hardware for leveling work. Grouting will be by the Mason.

END OF SECTION

PART 1: GENERAL

The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Furnish, fabricate and erect as required, all miscellaneous metal items indicated, noted or detailed on drawings and specified.

1.2 SHOP DRAWINGS

Provide complete shop drawings and setting drawings of all items for approval prior to fabrication.

Miscellaneous metal fabricators shall obtain all necessary field measurements at the job site and will be held responsible for their accuracy and for the accurate fitting of this work with the work of others.

PART 2: MATERIAL

All material shall be new and shall conform to ASTM designation for the metals used. All aluminum shall be 6063T5 or T6 alloy.

All Structural Steel to be ASTM A-36.

2.1 ANGLES, PLATES & LINTELS

Provide opening angles, lintels, and plates on roof and in walls, and miscellaneous supports shown, requiring fabricating in accordance with notes and details.

Provide all relieving angles, lintels and other steel supports for all masonry, and veneer, including bolts, inserts, etc., as required and not provided in other trade sections. Provide clip angles, channels, plates, etc., as per notes and details, including bolts, anchors, screws, shop and field connections, and miscellaneous fastenings required to make installation complete.

2.2 DISSIMILAR MATERIALS

Wherever dissimilar metals come in contact, lead or neoprene washers, spacers, gaskets, or other approved material shall be inserted between them to provide insulation against electrolytic action.

2.3 WORKMANSHIP

All work performed as per Standard Practice ACIS and National Association of Architectural Metal Manufacturers.

The fabricator shall verify all dimensions of work adjoining the work hereunder. Such other work shall be inspected before fabrication and/or installation of items specified herein. Measurements of adjoining work shall be obtained so that work shall fit closely to spaces provided.

Workmanship required in the execution of the work shall be of the best quality and subject to the approval of the Engineer.

The fabricator shall furnish all necessary templates and patterns required by other trades. He shall also furnish all items except as otherwise specified, pertaining to work hereunder that are to be built into structural work under other Sections. The erector shall supervise and be responsible for the proper location and installation of such built-in items.

Metal work shall be well formed to shape and size, with sharp lines and angles. Shearing and punching shall leave clean, true lines and surfaces. Permanent connections shall be welded or bolted where practicable.

Exposed surfaces of casting shall have a smooth finish and sharp lines and arises that are well defined. Joints shall be milled to a close fit.

Rivet and bolt heads shall be countersunk flush with surface.

Fastenings shall be concealed where possible. Thickness of metals and details of assembling and support shall give ample strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

Holes in structural steel framing for attaching miscellaneous metal items will be provided by the steel fabricator if information is given in ample time by the miscellaneous metal fabricator.

Welding shall be in accordance with current "Code for Arc and Gas Welding in Building Construction" of the American Welding Society. Exposed welded joints shall be ground smooth.

Miscellaneous metal work to be built-in shall be let into masonry, concrete and/or stone work as detailed or required, and in such cases, the holes shall be carefully drilled by this fabricator unless provided under other sections, and the work properly secured, poured with Por-Rok, molten lead or sulphur, sealed and neatly filled and finished.

2.4 SHOP PAINTING

All ferrous metals shall be given one (1) shop coat of zinc chromate rust inhibitive primer paint adaptable for light colored field painting. Wet mil thickness not less than four (4) mils; dry, not less than two (2) mils. Field touch-up shall be done by the erector using paint furnished by the fabricator.
Finish painting will be done by the painting subcontractor.

2.5 METAL STAIRS

Provide and install where indicated best quality steel stair with steel pan treads and steel risers, and/or steel sub-risers and sub-treads.

Pans shall be filled with poured-in-place concrete reinforced with wire mesh, trowelled smooth to receive covering, as noted on drawings, or be fitted with pre-cast treads as detailed.

All stair work shall be designed for a safe working load of 100 lbs. sq. ft., put together in a neat and workmanlike manner as detailed. Exposed bolt and screws shall be countersunk flush where possible.

Furnish and set all structural steel angles, channels, rails, hangers, etc. shown on the drawings or required for the execution of the work, except such as included in the work shown on the structural sheets.

Treads, platforms and risers shall be of not less the #12 gauge plate steel bent to the forms and properly connected. Steel for filled treads shall turn up to form beveled nosings at the front and sanitary cove at back of each tread. Treads and risers shall be carried on 1 1/4" X 1 1/4" x 3/16" steel angles securely bolted or riveted to the stringers and treads.

Provide tubular steel newell posts with caps if required.

Stringers shall be structural channels.

Platforms to be supported by angle framings.

Stairs shall be of approved manufacture.

Shop drawings shall be submitted for approval.

2.6 STEEL LADDERS

Fabricate ladders to comply with the requirements of ANSI A14.3.

Provide 3/8" x 2 1/2" continuous structural steel flat bar side rails with eased edges spaced at 18 inches apart.

Provide 3/4" diameter solid structural steel bar rungs spaced at 12 inches apart.

Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

Provide non-slip surface on the top of each rung, either by coating the rung with aluminum oxide granules set in epoxy resin adhesives, or by using a type of manufactured run which is filled with aluminum oxide grout.

Provide welded steel brackets to support ladder where detailed.

2.7 MISCELLANEOUS SUPPORTS

Provide and install steel supports as detailed for ceiling hung toilet partitions, brackets for counters, desk supports, supports for door tracks, and all others detailed or required.

2.8 PIPE RAILS (STEEL)

Provide and install steel pipe railings for stairs and steps where indicated.

Pipe railings shall consist of 1 1/4" inside diameter black steel pipe or square steel tubing, with necessary flanges and fittings, cast to the exact angle required, and secured to other work with lag screws in expansion shields or bolted to steel members where required. Where pipe rails occur in concrete work, they shall be bolted to flanged insert embedded in concrete.

Wall rails, where indicated, shall be returned at ends with flush fitting and shall be supported on brackets spaced not over 5 ft. apart. Brackets shall be secured with expansion bolts or toggle bolt as the case may require and finish hexagon nut.

PART 3: EXECUTION

Furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts, and other items having integral anchors which are to be embedded in concrete or masonry construction.

END OF SECTION

PART 1: GENERAL

The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Furnish all labor, materials, equipment, special tools, supervision and all services required to complete all rough carpentry work indicated, noted or detailed, or the drawings and specified herein.

Furnish all rough lumber, etc. and all labor necessary to install same. Any item or part required to complete the installation to that intended by the drawings shall be furnished and installed as though it were indicated, noted or specified.

Wood Grounds as required.
Wood nailing blocks as required.
Scaffolding.
All rough hardware of every description.
Boxing and guards necessary to protect pre-cast work, masonry, plumbing, fixtures, etc.
Wood vent curbs on roofs.
Miscellaneous shelving.

This also includes the temporary enclosing of the building and erection of barricade when required and the prompt performance upon request and without extra charge of all necessary cutting, framing, jobbing, etc. for other craftsmen on the building excepting only such as has been heretofore specified to be provided by them.

Read all other specifications for work by other trades and include all carpenter work and work in wood as part of the work under this Section.

Note that Specifications for wood from work required in connection with concrete is hereinbefore described in Division 3.

PART 2: MATERIALS

2.1 MATERIAL

Lumber:

1. Framing: Douglas Fir or Southern Pine, #1 Grade.
2. Studs: Standard or Stud Grade.
3. Grounds, blocking and nailers: standard or Utility Grade of above species.
4. All lumber shall be grade marked and trade marked.
5. Moisture Content: Kiln dried to maximum 15%.

Plywood:

1. Exterior Plywood: Medium density, trade marked EXT-DFPA, constructed of waterproof glue and grade marked A-C where one side is exposed, A-A where both sides are exposed and B-C where concealed.

2. Interior Plywood: Trade marked INT-DFPA or EXT-DFPA, constructed with moisture resistant glue, grade marked A-B where one side is exposed, A-A where both sides are exposed and B-D where concealed.

Treated Wood:

1. Conform to FS TT-W-571, Table 3.
2. All lumber in contact with masonry, concrete, or roof shall be redwood, cypress or preservative treated with water borne salt preservative, AWPI LP-2.
3. Brush all field cuts with preservative used in pressure treatment.
4. Lumber redried to maximum moisture content of 19%, marked DRY.
5. Fire Retardant Plywood: AWPA C 27.

Rough Hardware:

1. Bolts: FS-B-575.
2. Lag Screws and Bolts: FS FF-B-561.
3. Toggle Bolts, Expansion Shields: FS FF-B-588.
4. Wood Screws: FS FF-S-111.
5. Nails: FS FF-N-105.

2.2 STORAGE

All lumber shall be stored off the ground and kept covered and protected from the weather until used in the project.

PART 3: EXECUTION

3.1 PRELIMINARY AND ENCLOSING

Install studs at all entrance door openings and provide and hang temporary pattern doors fitted with hinges, lock and key. Provide temporary enclosures for all openings on the Ground Floor, or at ground level. Keep in proper repair until final doors and sash are installed.

3.2 LABOR

All labor employed shall be skilled and under the supervision of a competent foreman.

Furnish, set and maintain runways of ladders, leading from lowest level of the building to the roof, with proper landings at each floor for the general use of all workmen. Provide temporary 2 X 8 plank treads in metal pan stairs.

Build approved covers over sills, etc. exposed to falling materials or debris.

Protect all open well holes, shafts, etc. or other places in the building which are dangerous to like and limb with strong barricades.

3.3 GROUNDS

Furnish and set any grounds required. Grounds must be well secured in place, run true and plumb, and nailed to masonry by means of wall plugs.

3.4 NAILING PIECES

Carpenter shall provide wood furring, spot grounds of wood brick for insertion into walls where necessary and shall see that same are inserted into proper place during the construction of masonry.

3.5 HARDWARE INSTALLATION

Set all finishing hardware and protect same until building is accepted. Knobs and handles to be covered with flannel or similar material. All other hardware, such as nails, bolts, screws, and other rough hardware, shall be furnished by this contractor.

When finishing hardware is received at the building, the contractor shall check same, together with a representative of the hardware company, and he shall immediately report to the Engineers, any shortage of variation from the list furnished him. See specifications for finishing hardware.

3.6 SETTING DOOR FRAMES

Set all door frames and securely brace as approved.

3.7 UTILITY SHELVING

Furnish and install miscellaneous shelving in rooms wherever noted, scheduled or detailed. All shelving shall be 3/4" thick particle board "Novoply" or equal, and shall be supported on wood framing as detailed or wall cleats as detailed.

3.8 WOOD CURBS FOR ROOF VENTS

Vent curbs shall be as detailed and shall be constructed of pressure treated #1 yellow pine or Douglas Fir.

3.9 INSULATION EDGING

At edge of roofs install 6" wide X thickness indicated, wood nailers prior to installation of roof insulation specified in Division 7. Wood nailers at edges of gravel stops and fascias shall be untreated material. Nailers at edges of insulation that abut rising surfaces shall be pressure treated material.

3.10 BLOCKING FOR GRAVEL STOPS

Provide and install wood blocking cut to size and shape shown, bolted into walls or roof decks with staggered bolting as shown.

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Work includes installation of all insulation shown on the drawings.

1.2 SUBMITTALS

A. Submit manufacturer's product literature and installation instructions for type of insulation required.

B. Submit data showing physical properties of fasteners to be incorporated with this work, including test data from an independent testing laboratory showing pull-out resistance.

1.3 QUALITY ASSURANCE

A. Installer: To be a regularly engaged in the installation of insulation work specified and shall have have proper experience to install the work specified.

B. Manufacturer: The manufacturer shall be a company regularly engaged in the manufacturer of the insulation specified.

PART 2: MATERIAL

2.1 ROOF INSULATION (If required)

A. The roof insulation shall be Polyisocyanurate of the thickness stated on the drawings.

B. Thermal resistance: R=7.1 per inch thickness, conditioned

2.2 FIBERGLASS BATTEN WALL INSULATION

A. Where specified, fiberglass wall insulation shall be of the thickness called for and shall be manufactured by Owens-Corning, or equal.

B. Where called for, the insulation shall have an integral vapor barrier.

2.3 FOUNDATION PERIMENTER INSULATION

A. Foundation perimeter insulation shall be Owens Corning Foamular 250 Insulation, or equal, of the thickness stated on the drawings.

B. Thermal Resistance: R=5.0 per inch thickness, conditioned.

2.4 MASONRY FILL INSULATION (Not on this Project)

A. The exterior concrete masonry wall insulation shall be Cor-Fill 500 as manufactured by Tailored Chemical Products, Inc., or equal.

B. Product to be installed by injection into all open cores or through drilled holes in mortar joints. All holes to be repaired to appear as before drilling.

C. Thermal Resistance: R=20 for 12 inch block/60 lbs density.
R=14.2 for 8 inch block/60 lbs density.

PART 3: EXECUTION

3.1 INSTALLATION

All products to be installed in strict accordance with the manufacturer's installation specifications.

3.2 TRAINING

Where special training is required, the installer shall be trained in accordance with the manufacturer's training program and shall be experience in the installation of such work.

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

This section shall include all materials, equipment, and labor necessary for the installation of joint sealants on the project.

A. Qualified Applicator: Franchised by sealant manufacturer; at least three years experience in similar work with satisfactory results, subject to the Architect's approval. Install materials using experienced workmen, skilled in this type application, with equipment approved by the manufacturer.

1.2 SUBMITTALS

A. Submit manufacturer's specifications for the compounds; include methods of application and proposed color for each type of installation.
B. Submit color samples.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Acceptable temperature range for sealant Application: 65 deg. to 90 deg.
B. Stop exterior sealant work during inclement weather and do not restart until surfaces adjacent to the joint to be sealed are perfectly dry.

PART 2: PRODUCTS

2.1 MATERIALS

A. Multi-Component Urethane Sealant, for non-sag applications:
    1. Non-modified, air-curing, elastomeric sealant complying with ASTM C 920-86 Type M, Grade NS, Class 25. Select from on of the following manufacturers and products, or equal:
        a. Tremco, Dymeric.
        b. Pecora, Dynatrol II.
        c. Sonneborn Building Products, Sonolastic NP 2.
B. Multi-Component Urethane Sealant, for self-leveling applications:
    1. Complying with Federal Specification TT-S-00227E, Class A, Type 1:
        a. Tremco, THC-900.
        b. Pecora, Urexpan NR-200.
        c. Sonneborn Building Products, Sonolastic SL1.
C. Acrylic Latex Sealant:
    1. Complying with ASTM C-834-86.
        a. Tremco, Acrylic Latex 834.
        b. Pecora, AC-20.
        c. Sonneborn Building Products, Sonolac.
D. Sanitary Silicone Rubber., one part, moisture cure.
    1. Complying with ASTM C-920, Type S, NX, Class 25.
        a. Dow Corning, 786 Mildew Resistant Silicone Sealant.
        b. General Electric Company, Sanitary 1700 Sealant.
        c. Rhone-Poulenc Inc., Rhodorsil 6B.

E. Primer: As recommended by manufacturer for the use intended.
F. Primer (Silicone): As recommended by sealant manufacturer.
G. Backer Rod: Expanded, closed cell polyethylene; as recommended by sealant manufacturer.
H. Bond-Breaker: Polyethylene tape; as recommended by sealant manufacturer.

PART 3: EXECUTION

3.1 CONDITION OF SURFACES

A. Examine all surfaces which are to receive this work for any conditions detrimental to the proper or timely completion of this work. Do not proceed with this work until such conditions have been corrected and are acceptable.

3.2 JOINT DESIGN

A. Sealant joints shall conform to the following criteria.
    1. No joint less than 1/4 inch in width or depth.
    2. Joints up to 1/2 inch in width shall have equal depth.
    3. Joints over 1/2 inch in width shall have depth equal to 1/2 the width.
    4. Control joints in concrete slabs, 1/8 inch width.
B. Provide backer rod as specified to limit depth of joints. In shallow joints where use of backer rod is restricted, provide bond-breaker tape.

3.3 APPLICATION

A. Joints and spaces to be sealed shall be clean, dry and free from dust, loose mortar and other foreign materials.
B. Clean ferrous metals of all rust, mill scale and coatings by wire brush, grinding or sandblasting. Remove oils and grease with solvent-based materials such as Zylol, toluol or methyl ketone. Do not use soap, detergent or water soluble cleaners.
C. Mask adjacent surfaces with masking tape prior to priming and sealing. Remove tape after joint has been tooled.
D. After joints have been completely filled, they shall be neatly tooled to a slightly concave surface.
E. Immediately clean adjacent materials which have been soiled; leave work in a neat, clean condition.
F. Repair and correct defects in work due to faulty materials, methods of workmanship. Make good any adjacent work damaged by such defects.

3.4 DEFLECTIVE WORK.

A. The following types of failure will be adjudged defective work: breakage, cracking, crumbling, melting, shrinking, running, hardening or staining adjacent surfaces, adhesive failure and cohesive failure. Correct defective work.

3.5 COLOR.

A. Sealant, Generally: Color of the adjacent material which lies in the same plane as the sealant. Sanitary silicone sealant shall be white.

3.6 APPLICATION.

A. Use urethane type sealants as exterior where sealant is indicated or if not indicated, as required to provide a weather-tight joint between dissimilar materials.
B. Use acrylic latex type sealant at interior locations where indicated or required to provide a seal between dissimilar materials.
C. Use sanitary silicone sealant at interior locations between plumbing fixtures and building construction and between casework and wall construction.
D. Use one-part nonsag urethane sealant or multi-part nonsag urethane sealant (NT) for expansion and control joints in masonry, other than stone.

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 WORK INCLUDED

A. Furnish all items shown on drawings and as specified including, but not limited to, the following.
   1. Steel Doors.
   2. Steel Door Frames.
   3. Steel Sidelight, Borrowed lite & transom frames.

1.2 REFERENCES

A. Steel Doors and Frames must meet the following standards:
   1. Door and Hardware Preparation ANSI 115.
   2. Life Safety Codes NFPA-101 (Latest Edition).
   3. Fire Doors and Windows NFPA-80 (Latest Edition).
   4. Steel Door Institute ANSI/SDI-100 (Latest Edition).

1.3 QUALITY ASSURANCE

A. Provide Steel Doors and Frames manufactured by a single firm specializing in the production of this type of work.
B. Provide Steel Doors and Frames complying with the Steel Door Institute recommended specifications for Standard Steel Doors and Frames ANSI/SDI 100 (Latest Edition), and as herein specified.

PART 2: PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

A. Doors to be steel flush leafs by "Republic Builders Products, Ceco Door Products, or equal.

2.2 HARDWARE LOCATIONS AND GENERAL REINFORCEMENTS

A. Locate hardware on doors and frames in accordance with the manufacturers standard location.
B. Hardware reinforcements to be in accordance with minimum standard gages as listed in SDI-100.

2.3 STEEL DOORS

A. Material - Exterior Doors
   1. Face Sheets are to be made of commercial quality 18 gage hot dipped A60 zinc coated steel that complies with ASTM A525.
   2. Vertical edges shall join the face sheets by manufacturers standard weld pattern extending the full height of the door. Welds are to be ground, filled and dressed smooth to make invisible and provide a smooth flush surface.
   3. Hinge reinforcement shall be not less than 8 gage.
   4. Reinforce tops and bottoms of all doors with a continuous steel channel not less than 16 gage, extending the full width of the door and welded to the face sheet.

5. Door Cores - doors are to be completely filled with rigid polyurethane or polystyrene core chemically bonded to all interior surfaces.

B. Materials - Interior Doors
1. Face sheets are to be made of commercial quality 18 gage cold rolled steel that complies with ASTM A366 or 620.
2. Vertical edges shall be mechanically interlocked with a hairline edge scam.
3. Hinge reinforcement shall be not less than 8 gage.
4. Reinforce tops and bottoms of all doors with continuous steel channel not less than 16 gage, extending the full width of the door and welded to the face sheet.
5. Door Cores - Doors shall have a one piece resinimpregnated honeycomb core with sanded edges securely bonded to both face sheets.

2.4 STEEL FRAMES

A. Materials for all exterior frames.
1. Shall be 14 gage hot dipped A60 zinc coated steel that complies with ASTM designation A525.
2. All frames are to be assembled so that the face miter seam is closed and tight. Corners shall be welded.

B. Materials for all other frames.
1. Shall be 16 gage that complies with ASTM A366 or ASTM A568.
2. Frames to be assembled so that the face miter seam is closed tight. Frames shall be of "knock-down" construction.

C. Anchors.
1. Floor anchors at each jamb.
2. Anchors at masonry walls to be wire type not less than 0.156 inch diameter steel wire.
3. Anchors in stud partitions to be steel of suitable design, not less than 18 gage.
4. Except on weather strip doors, drill stop to receive 3 silencers on a single door frame and 2 silencers on a double door frame.

2.5 PRIME FINISH

A. Doors and frames to be cleaned, chemically treated, and all exposed surfaces receive factory applied coat of rust inhibiting primer.

PART 3: EXECUTION

3.1 INSPECTION

A. The G.C. shall make sure that all dimensions for openings are accurate.
B. The G.C. shall correct all scratches or disfigurements caused by shipping and handling.

3.2 INSTALLATION

A. Install doors per SDI-105 "Recommended Erection Instructions for steel Frames" and SDI-110 "Standard Steel Door and Frame for modular masonry construction.

3.3 ADJUST AND CLEAN

A. Check and re-adjust operating finish hardware items in hollow metal work just prior to final inspection. Leave work in complete and proper condition.
B. Immediately after erection, sand smooth any damaged areas of primer paint and touch up with compatible primer.

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.01 Summary

A. Section Includes: Kawneer Architectural Aluminum Storefront Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units.

1. Types of Kawneer Aluminum Storefront Systems include:
   a. Trifab® VG 451T Storefront System – 2" x 4-1/2" (50.8 x 114.3) nominal dimension; Thermal; Front, Center, Back, Multi-Plane, Structural Silicone or Weatherseal Glazed (Type B); Screw Spline, Shear Block, Stick or Punched Opening Fabrication.

1.02 System Description

Provide and install new window units as shown on the drawings.

A. Storefront System Performance Requirements:

1. Wind loads: Provide storefront system; include anchorage, capable of withstanding wind load design pressures according to the 2006 International Building Code as adopted by the State of Indiana
2. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air Infiltration rate shall not exceed 0.06 cfm/ft^2 (0.3 l/s · m^2) at a static air pressure differential of 6.24 psf (300 Pa).
3. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 8 psf (383 Pa) as defined in AAMA 501.
4. Uniform Load: A static air design load of 20 psf (958 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
5. Thermal Transmittance (U-factor): When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than:
   a. Glass to Exterior – 0.47 (low-e) or 0.61 (clear)
   b. Glass to Center – 0.44 (low-e) or 0.61 (clear)
   c. Glass to Interior – 0.41 (low-e) or 0.56 (clear)
6. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than:
   a. Glass to Exterior – 70_{frame} and 69_{glass} (low-e) or 69_{frame} and 58_{glass} (clear).
   b. Glass to Center – 62_{frame} and 68_{glass} (low-e) or 63_{frame} and 56_{glass} (clear).
   c. Glass to Interior – 56_{frame} and 67_{glass} (low-e) or 54_{frame} and 58_{glass} (clear).
7. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC): When tested to AAMA Specification 1801 and in accordance with ASTM E1425 and ASTM E90, the STC and OITC Rating shall not be less than:
   a. Glass to Exterior – 38 (STC) and 31 (OITC)
   b. Glass to Center – 37 (STC) and 30 (OITC)
   c. Glass to Interior – 38 (STC) and 30 (OITC)

1.03 Submittals

A. General: Prepare, review, approve, and submit specified submittals in accordance with "Conditions of the Contract" and Submittals Sections. Product data, shop drawings,

samples, and similar submittals are defined in "Conditions of the Contract."

B. Quality Assurance/Control Submittals:
   1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics.

1.04 Warranty

A. Project Warranty: Refer to "Conditions of the Contract" for project warranty provisions.
B. Manufacturer's Product Warranty: Submit, for Owner's acceptance, manufacturer's warranty for storefront system as follows:
   1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by supplier.

1.05 Quality Assurance

A. Qualifications:
   1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.
   2. Manufacturer Qualifications: Manufacturer capable of providing structural calculations, applicable independent product test reports, installation instructions, a review of the application method, customer approval and periodic field service representation during construction.
B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.06 Delivery, Storage, and Handling

A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
B. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
C. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

PART 2 - PRODUCTS

2.01 Manufacturers
A. Acceptable Manufacturers:
   1. Kawneer Company, Inc.
      555 Guthridge Court,
      Technology Park/Atlanta,
      Norcross, GA 30092
      Telephone: 770 449 5555
      Fax: 770 734 1560

C. Substitutions:

1. General: Refer to Substitutions Section for procedures and submission requirements.
   a. Pre-Contract (Bidding Period) Substitutions: Submit written requests seven (7) days prior to bid date.
2. Substitution Documentation
   a. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
   b. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for storefront system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum storefront for a period of not less than ten (10) years.
3. Substitution Acceptance: Acceptance will be in written form as an addendum prior to the bid opening.

2.02 Materials

A. Aluminum (Framing and Components):
1. Material Standard: ASTM B 221; 6063-T6 alloy and temper
2. Member Wall Thickness: Each framing member shall provide structural strength to meet specified performance requirements.
3. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.03 Accessories

A. Fasteners: Where exposed, shall be Stainless Steel.
B. Gaskets: Glazing gaskets shall be extruded EPDM rubber.
C. Perimeter Anchors: Aluminum. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
D. Thermal Barrier (Trifab® VG 451T):
1. Kawneer IsoLock® Thermal Break with a 1/4" (6.4) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.
   a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

2.04 Related Materials

A. Sealants: Refer to Joint Treatment (Sealants) Section.

2.05 Fabrication

A. General:
1. Fabricate components per manufacturer's installation instructions and with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
2. Accurately fit and secure joints and corners. Make joints flush, hairline and weatherproof.
3. Prepare components to receive anchor devices. Fabricate anchors.
4. Arrange fasteners and attachments to conceal from view.

2.06 Finishes
A. Factory Finishing:

1. Kawneer Permanodic® AA-M12C22A44, AAMA 611, Architectural Class I Color Anodic Coating. Color selected by Owner.

2.07 Source Quality Control

A. Source Quality: Provide aluminum storefront specified herein from a single source.
   1. Building Enclosure System: When aluminum storefront is part of a building enclosure system, including entrances, entrance hardware, windows, curtain wall system and related products, provide building enclosure system products from a single source manufacturer.

B. Fabrication Tolerances: Fabricate aluminum storefront in accordance with framing manufacturer's prescribed tolerances.

PART 3 – EXECUTION

3.01 Examination

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions. Verify openings are sized to receive storefront system and sill plate is level in accordance with manufacturer's acceptable tolerances.
   1. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

3.02 Installation

A. General: Install framing system in accordance with manufacturer's instructions and AAMA storefront and entrance guide specifications manual.
   1. Dissimilar Materials: Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.
   2. Weathertight Construction: Install sill members and other members in a bed of sealant or with joint filler or gaskets, to provide weathertight construction. Coordinate installation with wall flashings and other components of construction.
   3. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
   4. Provide alignment attachments and shims to permanently fasten system to building structure.
   5. Align assembly plumb and level, free of warp and twist. Maintain assembly dimensional tolerances aligning with adjacent work.

B. Related Products Installation Requirements:
   1. Sealants (Perimeter): Refer to Joint Treatment (Sealants) Section.
   2. Glass: Refer to Glass and Glazing Section.
      a. Reference: ANSI Z97.1, CPSC 16 CFR 1201 and GANA Glazing Manual.

3.03 Field Quality Control

A. Field Tests: Architect shall select storefront units to be tested as soon as a representative

portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

1. Testing: Testing shall be performed by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements. Testing Standard per AAMA 503, including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 Water Infiltration Test.
    a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft^2, whichever is greater.
    b. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.24 psf (300 Pa).

B. Manufacturer's Field Services: Upon Owner’s written request, provide periodic site visit by manufacturer’s field service representative.

3.04 Protection and Cleaning

A. Protection: Protect installed product's finish surfaces from damage during construction. Protect aluminum storefront system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

B. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Furnish labor, materials, equipment special tools, supervision and services to complete Gypsum Wallboard Systems indicated, noted, and detailed on drawings and specified herein, including wallboard and accessories.

1.2 RELATED WORK SPECIFIED ELSEWERE

Section 8110 Hollow Metal Frames
Section 9900 Painting

1.3 INDUSTRY STANDARDS

A. Publications of the following institutes, associations, societies, and agencies are referred to in this Section.
1. American Society for Testing and Materials, ASTM.
2. Underwriters' Laboratories, Inc., UL.
3. Federal Specifications, FS.

1.4 PRODUCT HANDLING

A. Gypsum Wallboard materials shall be delivered and stored to prevent damage.
1. Storage area shall be dry, weather-tight, and well ventilated.

1.5 PRODUCT HANDLING

Uniform temperature in the range of 55 degrees to 70 degrees shall be maintained during the installation and finishing of Gypsum Wallboard Systems.

1.6 QUALITY ASSURANCE

A. Acceptable Manufacturer's and Products.
1. United States Gypsum Company.
2. National Gypsum Company.
3. Georgia-Pacific Gypsum Company.

PART 2: PRODUCTS

2.1 MATERIALS

A. Materials shall conform to the following requirements of the 2015 International Building Code as adopted by the State of Indiana.

B. Gypsum Wallboard, unless otherwise specified shall be the following types, shall be:
1. Regular Board, taper edge, furnished 5/8" thick.
2. Fire Rated Board, taper edge, furnished 5/8" thick.
3. Moisture Resistant Board, taper edge furnished 5/8" thick.
4. Wallboard shall be thickness indicated furnished in stock widths and stock lengths.

C. Accessories, including corner beads, casing beads and trim, shall be furnished by the wallboard manufacturer as standard for the installed systems. Corner beads shall be screwed to wall, no crimp type.

D. Fasteners shall be Type S, Bulge Head wallboard screws at lengths required by mfg. Nails shall not be used.

2.2 EXAMINATION

A. Examine areas that are to receive drywall application.
1. Check alignment of supports, spacing, size and report any unsatisfactory conditions to the Architect. Do not proceed with drywall application until conditions have been corrected.

B. Wallboard system shall be fastened to steel framing using power driven screws.
1. Screws shall be spaced not less than 3/8" from edges and ends of wallboard, and shall be spaced 8" o.c. at joints and field.
2. Joints in wallboard shall occur only at stud locations

PART 3: EXECUTION

3.1 INSTALLATION

A. Drywall systems shall be complete, including supports, wallboard, and taping and spackling joints.

B. Floor and ceiling tracks shall be channel shape cold formed of galvanized sheet steel of sufficient width to receive studs.

C. Studs shall be spaced as shown on the drawings.

D. Wallboard shall be taper edge boards installed with long dimension vertical. Install ceiling first.
1. Fire Rated Boards shall be used for all walls indicated on the drawings as smoke or fire walls or as otherwise noted on the drawings.
2. Moisture Resistant Wallboard shall be used in damp or wet areas.
3. Moisture Resistant wallboard shall be used for all walls to receive ceramic tile.
4. Moisture Resistant wall board shall be used on the walls of all restrooms.

E. Provide corner at all outside corners, heads of unframed openings and other unprotected outside corners. Crimp type of metal corners shall not be used unless screwed also.

3.2 JOINT TREATMENT

A. All joints and internal corners shall be finished with joint tape and spackle as recommended by the wallboard manufacturer.
1. Apply joint compound sufficiently thick to hide board surface at angles and joints. Cover nail heads and depressions with compound.
2. Apply tape to angles and joints, squeeze out excess compound, and cover tape with compound.

When first coat has thoroughly dried, apply second coat and taper beyond edges of first

coat. Apply thin-finish coat of compound tapered beyond edges of second coat and sand to smooth surface, true to a plane.

3.3 CLEANING

Remove soil, stain, caused by installing of drywall materials. Clean and properly prepare drywall surfaces to receive finish, as specified.

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

The work of this section comprises the furnishing of all labor, materials, equipment, and services necessary for the installation of all acoustical ceilings, complete with suspension systems and related accessories as shown or scheduled on the drawings as specified herein.

1.2 EXPOSED GRID SYSTEM

System consists of suspension system to form an exposed metal grid pattern and lay-in acoustic control panels. All component parts shall be Underwriter's Laboratories, Inc., approved and rated materials for at least a one (1) hour rating where required.

Provide framing required for ceiling access for mechanical equipment. Provide additional hangers required to support ceiling mounted equipment, light fixtures, etc. Provide tie downs to prevent uplift of lay-in units.

1.3 WORK NOT INCLUDED

The following work is specified under other sections of the specifications as noted.

A. Furnishing and installation of all lighting fixtures and wiring to same are specified in Division 16.

B. Furnishing and installation of all ducts, ceiling grilles, return registers in connection with Heating & Air Conditioning are specified in Division 15.

PART 2: MATERIALS

2.1 EXPOSED SUSPENSION SYSTEM

A. Donn DX exposed grid system in restrooms and corridor. White in color.
1. Hangers: shall be not less than 12 gauge soft annealed galvanized.
2. Angle moldings shall be nominal 1" x 1" fabricated from cold formed steel.
3. All steel formed parts shall be electro-galvanized and shall receive a shop applied finish of baked enamel,.

B. Donn AX exposed grid all aluminum system in kitchen. White in color.
1. Hangers: 3’-0 o.c. as directed by the mfg.
2. Angle moldings shall be nominal 1" x 1" fabricated from cold formed aluminum.
3. All aluminum formed parts shall receive a shop applied finish of baked enamel.

2.2 ACOUSTIC PANELS

Refer to drawings for ceiling tile manufacturer, model, type, etc…

2.3 SAMPLES

Submit to the Architect for his approval samples of each type, style and size of acoustical units and suspension systems.

2.4 SHOP DRAWINGS

Provided shop drawings in the form of schedules showings type, style, size and method of suspension to be used in each area receiving acoustical treatment.

PART 3: EXECUTION

3.1 INSTALLATION

The suspension system shall support the ceiling assembly with a maximum deflection of 1/360 of the span. Seismic bracing as required by enforceable building codes. See Section 01000 Governing Codes for list of Codes to be used on this project.

Suspend main beams not more than 48" center to center with hanger wire tied securely and accurately leveled. Extra hangers shall be provided at light fixtures that are supported by grid system and at wall.

Main beams (tees) shall be spaced 4'-0" on center, with cross tees at 2'-0" on center to form a 4'-0" x 2'-0" grid module. Cross tees shall intersect and be positively locked into the main tees. Main tees shall be locked end to end. Tile board hold down clips shall be used as required. Wall moldings shall be securely fastened to walls, with main tees and cross tees resting on wall moldings.

END OF SECTION

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Furnish and install all resilient tile and sheet flooring indicated, noted, detailed or scheduled on the drawings and specified herein, complete with vinyl base.

1.2 DESCRIPTION OF WORK

A. Extent of resilient flooring an accessories is shown on the drawings and in schedules and includes:

1. Vinyl Composition Tile.

2. Rubber Base.

1.3 QUALITY ASSURANCE

A. Manufacturer: Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

B. Fire Test Performance: Provide resilient flooring which complies with the following fire test performance criteria as determined by an independent testing laboratory acceptable to authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of resilient flooring and accessory.

PART 2: PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following, or equal.

1. Vinyl Composition Tile

a. Armstrong Commercial Flooring
b. Congoleum Commercial Flooring

2. Rubber Wall Base

a. Armstrong Commercial Flooring
b. Congoleum Commercial Flooring

2.2 MATERIALS:

A. Provide color and patterns as selected by the Architect from the manufacturer's standards. Each room in which vinyl composition tile is indicated on the Finish Schedule shall have two colors. 80% of one color and 20% of another color. Pattern selected by Owner.

B. Vinyl Composition Tile Armongstrong Multicolor 12" x 12" x 1/8".

C. Rubber Wall Base: Provide rubber base complying with ASTM 1861-98. With matching end shops and preformed or molded corner units.

1. Height: 4"
2. Thickness: 1/8"
3. Style: Standard top-set cove, and straight as indicated.
4. Finish: Matte.

D. Divider Strip. Provide and install divider strips at the intersections of flooring and other floor covering as required.

F. Adhesive. Shall be as manufactured and recommended by the tile manufacturer. For above, below or on grade installation.

G. Selection. Color and design selection for flooring and bases shall be made by the Architect from any or all samples in the manufacturers complete line. Provide one complete box of samples of each tile and base available from which selection will be made.

H. Extra Material. Deliver to the Owner, for use in maintenance work, the following materials, matching that used in the project:

a. Vinyl Tile	2 cartons	each color
b. Vinyl Base	15 lin. ft.	each color, ea size

2.3 PRE-INSTALLATION

Store tiles in room where they are to be installed for 24 hours with temperature maintained at 70 deg.

Clean and inspect sub-floors, patch small holes and uneven surfaces with Latex Under-layment applied with a steel trowel.

Test concrete sub-floors for moisture prior to priming.

PART 3: EXECUTION

3.1 INSTALLATION

All tile shall be laid in strict accordance with manufacturers specifications, and shall be laid and cemented with approved waterproof adhesive. Install tile starting at center axis, scribing and fitting neatly at walls, around columns, under cabinets and around door frames.

Install a divider strip at all doors.

Apply Vinyl Tile Bases Continuous to thoroughly dry walls and cabinet bases. Corners shall be field formed, skive front for internal corners and back for external corners. Heat base when forming and hold to corner until set. Apply mastic and set in place.

3.2 CLEANING

Contractor shall clean the newly installed VCT tile floor with Armstrong S-485 Commercial Floor Cleaner, install one coat of Armstrong S-495 Commercial Floor Sealer, and two coats of Armstrong S-480 Commercial Floor Polish.
All cleaning, sealing, and polishing shall be done per mfg. standards – see attached.

Keep all traffic off finished floors after cleaning. Apply Kraft paper with taped joints as protection to cleaned floors as required.

An electric polishing machine shall be used to apply floor polish.

END OF SECITON

PART 1: GENERAL The General Conditions and other Contract Documents are hereby made a part of this Section to the same extent as if written out in full.

1.1 SCOPE

Furnish all labor and materials required to complete all painting, enameling or finishing, indicted, note, detailed or scheduled on the drawings and specified herein. It is the intent of this Section to require the painting subcontractor to finish all materials, equipment and items installed by all trades including Mechanical & Electrical. Painting Subcontractor shall also be responsible for the finishing of areas damaged or disturbed during construction time. Factory finished items will not require additional finishing.

PART 2: PRODUCTS

2.1 MATERIALS

This specification will make no attempt to define the composition or physical properties of the paints to be applied.

All paints shall be the maker's top professional brand, delivered to the site in the original unopened sealed containers.

Materials are specified under type of surface to be finished. Equal products by MAB or Porter may be used.

Vehicles shall be as recommended by the manufacturer of the particular product used. Thinning shall be done only in accordance with the manufacturer's recommendations using only thinning or reducing materials meeting manufacturer's approval.

No claim by the Contractor concerning the unsuitability of any material specified or his inability to produce first-class work with same will be entertained unless such claim is made in writing to the Engineer before the Contract is signed. Deliver materials in original sealed containers.

Painting contractor will submit name of material manufacturer and supply Architect, through Prime Contractor, with color selection charts, chips, etc., if same are not available in Architect's office, for all color selection.

No painting to be done until final samples are approved.

2.2 EXTERIOR PAINT SCHEDULE

2.3 INTERIOR PAINT SCHEDULE

A. Painted Gypsum Drywall:
1. Application by brush and roller.
2. First Coat: Latex Primer
   a. Sherwin Williams PrepRite 200 Latex Primer
3. Second and Third Coats: Interior Vinyl Acrylic
   a. Sherwin Williams ProMar 200 Interior Latex Eg-Shel

B. Painted Hollow Metal Steel Door and Frame:
1. Application by brush and roller.
2. First Coat: Latex Primer
   a. Sherwin Williams PrepRite 200 Latex Primer
3. Second and Third Coats: Interior Vinyl Acrylic
   a. Sherwin Williams ProMar 200 Interior Latex Semi-Gloss

PART 3: EXECUTION

3.1 FINISH THICKNESS

All painting and finishing work done in this project shall have a minimum total dry film thickness (DFT) of not less than that noted hereinafter, with spreading rate noted.

3.2 WORKMANSHIP

The painting subcontractor shall be responsible for inspecting the work of others prior to the application of any paint or finishing material. If any surface to be finished can- not be put in proper condition for finishing by customary cleaning, sanding and putty operations, the painting subcontractor shall immediately notify the General Contractor in writing; or assume responsibility for and rectify any unsatisfactory finish resulting.

Backpriming will be required for all interior and exterior wood items.

Each coat of paint shall be slightly darker than preceding coat unless otherwise directed by Engineer or Owner. Undercoats shall be tinted similar to finish coats.

Prime coats will not be required on items delivered with prime or shop coats already applied. Touch-up primer or shop coats.

Field painting will not be required on items specified to be completely finished at factory or on aluminum copper, brass, bronze and other non-ferrous metal unless specifically designated.
Interior caulking will be painted.

3.3 STORAGE

All materials used on the job shall be stored in a single place designated by the General Contractor and approved by the Engineer and Owner. The storage area must be kept clean and neat. Floors shall be adequately protected from spillage with proper covers. Any oil rags, waste, etc., must be removed each night after being placed in a covered receptacle during the day.
All precautions against fire must be taken.

3.4 PREPARATION

All surfaces to be painted or finished shall be prepared carefully and inspected before starting the work. No paint or other finish shall be applied until the surfaces are absolutely clean, dry and in proper condition to receive the work.

END OF SECTION

PART 1: GENERAL The provisions of DIVISION 1 and DIVISION 2 preceding these specifications are part of these specifications and this Contractor is to consult them for instructions pertaining to the work under this heading. Note particularly the section on "Proposals ,and Alternates" preceding these specifications.

Where work covered by this specification connects to equipment furnished by others, this Contractor shall check the equipment in the field and will be held responsible for the proper connections to such equipment.

Wherever the phrase "this Contractor" is used in the Article, it refers to the specific contractor involved.

1.1 CONTRACTOR'S NOTE

Immediately upon awarding of the contract, the Contractor must confer with the General Contractor on the building and arrange for proper provisions to be made for the carrying on of all work provided in this specification.

The Contractor shall order all equipment immediately upon signing of contract or receipt of notice to proceed and upon approval of shop drawings. He shall notify the General Contractor of delivery dates and changes therein in writing with copy of written notice to the Architect. He shall check accesses for equipment to insure doorways, hatches, etc., are sufficient to pass any equipment required. It will be the Contractor's responsibility to prevent any undue delay by reason of delayed or postponed shipment dates.

1.2 OPEN COMPETITION

Where manufacturer's names or trade names are mentioned throughout these Plumbing, Heating, Ventilating & Electrical Specifications, it is done for the express purpose of establishing quality or type of design and not for limiting competition. Other manufacturers' products may be used if, in the opinion of the Engineer, they are equal in all respects and meet the specifications as hereinafter described or shown on the drawings.

1.*3 GUARANTEE*

Each Contractor shall keep his entire portion of the work in repair, so far as defects in workmanship, apparatus, or material or construction are concerned, for one (1) year from date of final certificate, without further charge; but this clause shall not be interpreted as holding him responsible for making good any deterioration due to it's use or abuse.

Any equipment installed by this Contractor which fails to meet performance ratings specified and shown on drawings shall be removed and replaced by equipment which meets all specified requirements without additional cost to the Owner.

1.4 DRAWINGS

This Contractor shall have a set of General, Structural, Mechanical and Electrical drawings on the site, and before installing any of his work he shall see that it does not interfere with clearance required for foundations, finished columns, pilasters, partitions, wall, electrical outlets, etc., and structural members as shown on the General drawings and details. If work is so installed and it develops that interferences

occur which have not been called to the Architect's attention before it's installation, this Contractor, at his own expense, shall make such changes in his work as directed by the Architect.

1.5 AS CONSTRUCTED DRAWINGS

In order that the Architect may make corrections to contract drawings, this Contractor shall, during the progress of the work, furnish the Architect with sketches or prints of drawings marked in colored pencil showing the exact, as installed, location of any concealed work which deviates in any way from the contract drawings.

1.6 SHOP DRAWINGS

Shop drawings shall be submitted as set forth by the GENERAL CONDITIONS.

1.7 OPERATING INSTRUCTIONS

At the termination of this Contractor's work, at the time the building is officially turned over to the Owner, this Contractor shall furnish to the Owner a complete portfolio containing shop drawings, operating instructions, etc., on all equipment furnished by him under this contract. Also, he shall furnish a competent instructor to advise the maintenance personnel as to the proper operation and servicing of any special equipment installed by him.

1.8 LEAK DAMAGE

This Contractor shall be responsible for damage to the work of other Contractors or to the building and it's contents caused by leaks in any of the equipment installed by him or by disconnected pipes, fittings, overflows, freeze-ups, etc.

1.9 CLEANING OF PREMISES

This Contractor shall keep the premises clean of all debris caused by his work at all times, and shall keep his materials stored in such a manner so as not to interfere with the progress of the work of other contractors.

Remove all labels and clean all equipment before final inspection.

1.10 PAINTING

All painting of new work will be done by the General Contractor under his portion of the specification, but the Mechanical and Electrical Contractors shall clean all equipment, pipe, insulation, valves, conduit, boxes, etc., to be painted. All labels except those required by law shall be removed. All loose scale, dust and dirt shall be removed.

1.11 ADJUSTMENTS TO BUILDING CONDITIONS

The location and arrangement of the various parts of the installation are indicated on the drawings. Under no circumstances shall any sizes be decreased or radical changes in any part of the installation be made without the written consent of the Engineer.

When necessary to fit and center with tile, plaster and/or other paneling of wall space, this Contractor must, at his own expense, shift the fixture, grille, or other outlet as directed by the Architect or his representative. Note that prior to installation of suspended tile ceilings the Mechanical and Electrical Contractors shall coordinate tile pattern with the General Contractor.

1.12 COORDINATION OF CONTRACTORS

All sub-contracts shall be made strictly subject to the approval of the Engineer.

Each bidder shall file with his proposal a list of sub-contractors proposed for the principal parts of the work he proposes to sub-let and receive Architect's approval before any work is sub-let.

The Owner reserves the right to let other contracts in connection with this work. This Contractor shall extend to other contractors reasonable opportunity for the introduction and the storage of their materials and the execution of their work. This Contractor shall cooperate to the best of his ability with other contractors on the work and shall properly connect and coordinate his work with theirs.

In the interest of a properly coordinated and integrated Electrical System, the Electrical Contractor shall furnish and install all motor circuit wiring and control circuit wiring, together with connection to all electrical Drawings, or described in the Electrical Specifications. This will include standard starters, circuit breakers, cut-outs, separable attachment devices, control stations, etc., as indicated by symbol or description.

Other contractors whose equipment includes electrical components which require electrical accessories and wiring shall furnish the motor starters, controls, etc., which are ordinarily built into their equipment. The other contractors shall also furnish all externally mounted auxiliaries and electrical devices which are special accessories to their equipment. These include pressure, float, temperature, time liquid flow, and limit switches. Also, "T-stat", damper controls, relays, special devices and non-standard attachments.

Electrical services and connections to the other contractors' equipment, insofar as can reasonably be determined beforehand, are shown on the Electrical Drawings and shall be completed by the Electrical Contractor. Deviations, modifications and additions to the Electrical part of the other contractors work as described, however, shall be the responsibility of the other contractors.

Other contractors shall cooperate with the Electrical Contractor on the location of the outlet boxes, switches, controls, etc. They shall also be responsible for the correct locations of all the above items pertaining to their equipment and shall provide for all labor required to mount in place the various items of equipment except for the electrical hook-up.

All electrically operated or electrically controlled equipment which is furnished by other contractors shall have voltage, phase and frequency characteristics to match the system as described in the Electrical Specifications.

1.13 ERECTING

Each contractor shall do all erecting and installing work promptly, and as the work of other contractors progresses in such manner as not to cause delay to other contractors.

All wall sleeves in brick, concrete block, or concrete walls or slabs to receive piping shall be placed by this contractor as the structure is placed in order to avoid necessity for cutting through finished work. No cutting of finished work will be permitted except as approved by the Architect. Should any cutting of finished work be necessary, all patching shall be done by this Contractor to match adjoining work and original paint finish shall be completed from wall to wall. No patch painting will be accepted.

1.14 WALL CHASES

Each contractor must superintend the building of chases for pipes in walls. He shall furnish the necessary information in this regard to the General and Masonry Contractors at the proper time, and he will be held responsible for the correct size and location of chases, as these may not be shown on the other contractors' drawings.

1.15 CUTTING AND PATCHING

Each contractor shall do all cutting, fitting, and patching necessary to properly install his work unless specifically noted otherwise in these specifications or on the drawings.

1.16 EXCAVATION

Each contractor shall do any and all excavation necessary in the construction of his particular part of the work as included in these specifications, and all sheathing and bracing with proper material which may, in the opinion of the Architect, be necessary for the protection of foundations and walls of the building, and shall keep all excavations free from water by pumping or bailing during the progress of the work.

All surplus earth shall be removed from the premises or disposed of on the premises as directed by the Architect and Owner.

Compaction of soil shall be as stated in the Section 2200 Soil Conditions for all trenching.

A line shall be used to mark out trenches for sewers, pipe, etc., and there shall be no variation from the drawings except by order of the Engineer.

1.17 STANDARDIZATION

Insofar as possible, materials shall be standardized, i.e., all steel pipe of one brand, all specialities of one make, all valves of one make, all panels of one make, all switches of one make, all starters of one make, etc.

1.18 MARKING OF VALVES AND EQUIPMENT

Each and every valve which controls supplies to fixtures or appliances which are not directly adjacent and fixable, including all valves in basement, shall be tagged by the contractor whose equipment is served, with a brass tag wired on with No. 10 copper wire

1.19 CODE BANDING

All pipes shall be code-banded or stenciled near each valve and branch take-off from main and at intervals of not less than every 50 feet on long exposed runs. This shall be done after final coat of paint is

applied. The owner shall be consulted before applying code banding or stenciling and his code used when applicable.

1.20 ELECTRICAL MOTORS AND WIRING

All electric wiring for heating and ventilating and plumbing equipment will be done under the Electrical Specifications except as otherwise specified. The Electrical Contractor shall furnish combination line starters and push-button stations, unless they are specifically called for in the Mechanical Specifications. The Mechanical Contractor shall be responsible for the procurement of manufacturer's wiring diagrams which will correlate the equipment to be furnished by the Electrical Contractor with the respective manufacturer's specialties.

The required voltage for each motor is given with each class of equipment. All motors shall conform to applicable NEMA Standards for quiet operation, standard frame size, permissible temperatures rise and suitable enclosure for the service intended.

1.21 CONCRETE

See Sections 3100 Concrete Form Work, Section 3200 Concrete Reinforcement, and Section 3300 Cast-In-Place Concrete for more information on concrete requirements.

1.22 FOUNDATIONS

All motor-driven equipment on basement floor and their accessories shall be installed on concrete foundations 4" high, unless otherwise specified or noted on the drawings. Note that certain foundations will be provided by the General Contractor; however, this Contractor shall furnish him the exact dimensions of the foundation required.

1.23 CLEANING OF PIPING AND DUCTWORK SYSTEMS

Each piping system shall be thoroughly cleaned by flushing out with water prior to turning over to the Owner.

Domestic water systems of plumbing shall be thoroughly flushed out and flushing water wasted to sewer for a period not less than 15 minutes. Mains shall be flushed first by flushing out the furthest branch lines and progressing backwards toward source, flushing each branch line. Valve discs shall be removed before flushing except branch shut-off valve.
Ductwork shall be kept clean as it is erected by vacuuming out or by wiping out dirt, grease and oil. Ductwork systems shall not be used for temporary ventilation unless the Contractor furnishes and maintains filters in all locations as seemed necessary to keep system clean. Filters shall be changed regularly every two weeks in order to keep system clean of construction dirt. Covers shall be placed over inlets and outlets not in temporary use during construction.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this and all Sections of Divisions 20, 21, 22 and 23.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:

1. Requirements of Regulatory Agencies.
2. Abbreviations contained in Specifications.
3. Shop Drawings.
4. Record Drawings
5. Operation and Maintenance Manuals.
6. Drawings.
7. Construction Documents.
8. Work and Workmanship.
9. Coordination between Contractors.
10. Assignment of Miscellaneous Work.
11. Equipment Warranty and Early Equipment Startup.
12. Material Equipment Transport
13. Material Storage.
14. Product and Material Approval.
15. Protection and Treatment of Property.
16. Demolition and Removal of Equipment.
17. Electrical Connections to Equipment and Control Wiring.
18. Attaching to Building Construction.
19. Rough-ins.
20. Mechanical Installations.
21. Cleaning and Touch-up.
22. General Completion Startup/Owner Orientation.
23. Air Filters.

1.3 REQUIREMENT OF REGULATORY AGENCIES

A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.

B. In case of difference between building codes, specifications, state laws, local ordinances, industry standards, utility company regulations and Contract Documents, the most stringent shall govern. Contractor shall promptly notify Engineer in writing of any such difference.

C. Non-compliance: should Contractor perform any work that does not comply with requirements of applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.

D. Applicable codes and standards shall include all state laws, local ordinances, utility company regulations and applicable requirements of the most recent editions of the following nationally accepted codes and standards:

1. The Indiana Building Code. (IBC)
2. The Indiana Electric Code.
3. The Indiana Mechanical Code. (IMC)
4. The Indiana Fuel-Gas Code.
5. The Indiana Fire Code.
6. The Indiana Plumbing Code. (IPC)
7. The Indiana Elevator Code.
8. The Indiana Handicapped Accessibility Code.
9. National Fire Protection Associates (NFPA) codes and regulations.
10. Regulations of the Indiana State Board of Health.
11. Regulations of the Insurance Bureau of Indiana.
12. Requirements of Factory Mutual (FM).
13. Regulations of the Indiana Department of Fire Prevention and Building Services.
14. The Americans with Disabilities Act (ADA).
15. All local and municipal codes and/or regulations.

E. Except as otherwise specified herein, all piping work and materials are to conform to the American Standards Association Code for Pressure Piping.

F. All fired and unfired pressure vessels furnished and installed under this contract are to conform to all requirements of current edition of State of Indiana Rules and Regulations for Boilers and Unfired Pressure Vessels. Copies of all certificates of tests and construction as required by this code to be turned over to Owner.

G. Permits: Contractor shall pay for all building permits required by work and permits for opening streets and for connection to various utilities, including fees for water meter installation and any other requirements necessary to carry out his work. Where streets or sidewalks are cut, same must be repaired to at least as good a condition as they were before, all at expense of this Contractor. Permits shall be posted in a prominent place at building site properly protected from weather and physical damage.

1.4 ABBREVIATIONS CONTAINED IN SPECIFICATIONS

A. AABC Associated Air Balance Council
B. AASHTO American Assn. of State Highway and Transportation Officials
C. ABMA American Bearing Manufacturers Association (formerly Anti-Friction Bearing Manufacturers Associates)

D.	ABMA	American Boiler Manufacturers Association
E.	ACI	American Concrete Institute
F.	ACIL	The Association of Independent Scientific, Engineering, and Testing Firms
G.	ACPA	American Concrete Pipe Association
H.	ADA	Americans with Disabilities Act
I.	ADC	Air Diffusion Council
J.	AFBMA	Anti-Friction Bearing Manufacturers Association (see ABMA)
K.	AGA	American Gas Association
L.	AIA	American Insurance Association
M.	AIHA	American Industrial Hygiene Association
N.	AISC	American Institute of Steel Construction
O.	AISI	American Iron and Steel Institute
P.	AMA	Air Moving & Conditioning Association
Q.	AMCA	Air Movement and Control Association International, Inc.
R.	ANSI	American National Standards Institute
S.	API	American Petroleum Institute
T.	AREA	American Railway Engineering Association
U.	ARI	Air-Conditioning and Refrigeration Institute
V.	ASA	American Standards Association
W.	ASA	Acoustical Society of America
X.	ASC	Adhesive and Sealant Council
Y.	ASHRAE	American Society of Heating, Refrigerating & Air-Conditioning Engineers
Z.	ASME	American Society of Mechanical Engineers
AA.	ASPE	American Society of Plumbing Engineers
BB.	ASTM	American Society for Testing Materials
CC.	AWS	American Welding Society
DD.	AWWA	American Water Works Association
EE.	AABC	Associated Air Balance Council
FF.	CAGI	Compressed Air and Gas Institute
GG.	CE	Corps of Engineers (U.S. Department of the Army)
HH.	CGA	Compressed Gas Association
II.	CISPI	Cast Iron Soil Pipe Institute
JJ.	CPPA	Corrugated Polyethylene Pipe Association
KK.	CTI	Cooling Tower Institute
LL.	DIPRA	Ductile Iron Pipe Research Association
MM.	DOT	Department of Transportation
NN.	EPA	Environmental Protection Agency
OO.	FAA	Federal Aviation Administration
PP.	FCC	Federal Communications Commission
QQ.	FDA	Food and Drug Administration
RR.	FIA	Factory Insurance Association
SS.	FCI	Fluid Controls Institute
TT.	FM	Factory Mutual System
UU.	HEI	Heat Exchange Institute
VV.	HI	Hydraulic Institute
WW.	HI	Hydronics Institute (Division of Gas Appliance Manufacturers Association)
XX.	INCE	Institute of Noise Control Engineering
YY.	IEEE	Institute of Electrical & Electronic Engineers
ZZ.	IRI	Industrial Risk Insurance

AAA.	ISA	International Society for Measurement and Control
BBB.	ITS	Intertek Testing Services (Formerly Inchcape Testing Services)
CCC.	MCAA	Mechanical Contractors Association of America
DDD.	MSS	Manufacturing Standardization Society of the Valve and Fittings Industry
EEE.	NACE	National Association of Corrosion Engineers
FFF.	NBS	National Bureau of Standards
GGG.	NCAC	National Council of Acoustical Consultants
HHH.	NCCA	National Coil Coaters Association
III.	NCPI	National Clay Pipe Institute
JJJ.	NCSPA	National Corrugated Steel Pipe Association
KKK.	NEBB	National Environmental Balancing Bureau
LLL.	NEC	National Electric Code
MMM.	NECA	National Electrical Contractors Association
NNN.	NEMA	National Electrical Manufacturers Association
OOO.	NETA	InterNational Electrical Testing Association
PPP.	NFPA	National Fire Protection Association
QQQ.	NIA	National Insulation Association (Formerly National Insulation and Abatement)
RRR.	NIST	National Institute of Standards and Technology (U.S. Department of Commerce)
SSS.	NUSIG	National Uniform Seismic Installation Guidelines
TTT.	OSHA	Occupational Safety & Health Administration (U.S. Department of Labor)
UUU.	PCA	Portland Cement Association
VVV.	PDI	Plumbing and Drainage Institute
WWW.	PPFA	Plastic Pipe and Fittings Association
XXX.	PPI	Plastics Pipe Institute
YYY.	RMA	Rubber Manufacturers Association
ZZZ.	SAE	SAE International
AAAA.	SAE	Society of Automotive Engineers
BBBB.	SMACNA	Sheet Metal & Air Conditioning Contractors' National Association
CCCC.	STI	Steel Tank Institute
DDDD.	SWPA	Submersible Wastewater Pump Association
EEEE.	UL	Underwriters Laboratories
FFFF.	UNI	Uni-Bell PVC Pipe Association
GGGG.	WSC	Water Systems Council

1.5 SHOP DRAWINGS

A. Review of Shop Drawings does not relieve Contractor of responsibility for correct ordering of material and equipment.

B. Contractor review should ensure that equipment will fit into available space.

C. Shop Drawings shall be prepared and submitted in accordance with Division 1 "Submittals".

D. Include all significant data on Shop Drawing Submittals shown in Specifications and Equipment Schedule. Including, but not limited to the following:

1. Name each piece of equipment by scheduled name, noted as: "Mark No." as indicated on drawings, i.e., FC-A, CSAC-A, etc.
2. Pressure drops at design flow.

3. Electrical characteristics and wiring diagrams: Power, signal, and control wiring. Wiring diagrams must match the equipment provided. Custom factory wiring such as terminal strip designations must be provided. Costs associated with field changes required if accurate wiring diagrams are not provided shall be borne by the equipment manufacturer.
4. Description of construction and material types and gauge of materials used.
5. Entering and leaving air and or water temperature at design conditions.
6. Performance characteristics/efficiency.
7. Dimensional drawing showing locations of all field connections including piping, control, power and sheet metal as well as equipment configuration.
8. Dimensional drawing showing locations of all field connections including piping, control, power and sheet metal as well as equipment configuration.
9. Note any special tools required for equipment service.

E. Items Requiring Submittals:

1. Each individual section lists the required items to be submitted.

1.6 RECORD DRAWINGS

A. Contractor shall be responsible for furnishing to Engineer a complete, accurate and neat set of marked-up blueline drawings in accordance with Division 1. This set shall contain all deviations between actual construction and Contract Drawings.

B. Contractor shall maintain a mark-up set of as-built drawings on the project site and shall keep all drawings up-to-date as construction progresses. This marked-up set shall be returned to Contractor, as many times as necessary, in order to obtain desired results.

C. Engineer's employees shall inspect Drawings regularly on project site for accuracy and omissions. Pay request will not be approved if marked-up record drawings are not onsite and up to date.

D. Refer to Division 1 “PROJECT CLOSEOUT” for further instructions.

1.7 CONSTRUCTION DOCUMENTS

A. Construction documents shall include all divisions of specifications, all drawings and all issued addenda.

B. In a case of conflict between the drawings and specifications, or between divisions of specifications, the most stringent condition shall apply.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Prepare Operation and Maintenance Manuals including the following information for equipment items:

1. Complete index identifying contents of manual. Also provide a comprehensive list of manufacturers, suppliers, subcontractors, etc., with name of contact person, address and phone number for each manufacturer, supplier and subcontractor.
2. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and exploded drawing of devices with names and part numbers of replacement parts.
3. Complete set of reviewed shop drawings.
4. 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.
5. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
6. Servicing instructions and lubrication charts and schedules.
7. Warranty letter from contractor stating general warranty and any extended warranty items included in this contract.
8. Refer to Division 1 "Contract Closeout" for additional instructions.
9. O&M Manuals shall also be submitted in electronic format and neatly organized to the satisfaction of the engineer.

1.9 DRAWINGS

A. Mechanical Drawings show general arrangement of all piping, equipment and appurtenances. They shall be followed as closely as actual building construction and work of other trades will permit. Mechanical work shall conform to requirements shown on all Drawings. General and Structural Drawings shall take precedence over Mechanical Drawings. Because of small scale of Mechanical Drawings, it is not possible to indicate all offsets, fittings and accessories, which may be required. Contractor shall investigate structural and finish conditions affecting work and shall arrange his work accordingly, providing such fittings, valves and accessories as may be required to meet such conditions.

B. For purpose of clarity and legibility, Drawings are essentially diagrammatic, although size and location of equipment and piping are drawn to scale wherever possible. Verify Contract Document information at site.

C. Drawings indicate required sizes and points of termination of pipes and ducts and suggested routes. It is not the intention of Drawings to indicate all necessary offsets. Install work in manner to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear. Do not scale from Drawings.

D. In case of a conflict in construction documents and or the specifications, Contractor shall receive clarification, prior to bidding, in the form of an addendum or include in his price, the greater amount of work of the conflicts shown. (i.e., if two pipe sizes are indicated for the same pipe, the Contractor shall price the larger of the two pipes.)

1.10 WORK AND WORKMANSHIP

A. Provide all required labor, materials, equipment and Contractor's services necessary for complete installation of systems required in full conformity with requirements of authorities having jurisdiction; and as indicated on Drawings and herein specified.

B. Finished job shall be functional and complete in every detail, including any and all such items required for a complete system, whether or not these items are specified or shown on drawings.

C. Any apparatus, material or work not shown on Contract Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories or minor details not shown but necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided without additional expense to the Owner.

D. Special attention shall be given to accessibility of working parts and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.

E. Each Contractor shall acquaint himself with details of all work to be performed by other trades and take necessary steps to integrate and coordinate his work with other trades.

F. It is assumed the Mechanical Contractor is familiar with standard first-class installation procedures. Therefore, these Specifications do not attempt to include every detail or operation necessary for the complete installation.

G. It should be particularly noted that the terms "furnish" and "provide" are interchangeable and that each of these terms means to provide, install and connect, unless otherwise stated.

H. Whenever tables or schedules show quantities of materials, they shall not be used as a guide to Contractor. Each Contractor shall be responsible for furnishing all materials noted on Drawings and as specified.

I. Craftsman trained in each respective trade shall install work in that trade.

1.11 COORDINATION BETWEEN CONTRACTORS

A. Note: Respective contractor infers the contractor installing the work.

B. Each Contractor and Subcontractor shall study all Drawings applicable to this work so complete coordination between trades will be affected. Special attention shall be given to points where ducts cross other ducts or piping, where lights fit into ceilings and where pipe, ducts and conduit pass through walls and columns. Temperature controls interface, where applicable, shall be given attention.

C. It is responsibility of each Contractor and Subcontractor to leave necessary room for other trades. No extra compensation will be allowed to cover cost of removing piping, conduit, ducts or equipment found encroaching on space required by others.

1.12 ASSIGNMENT OF MISCELLANEOUS WORK

A. Lintels required by Contractor in new or existing walls shall be furnished by Respective Contractor. Contractor shall be responsible for notifying other Contractor of correct size and locations for all lintels prior to wall construction.

B. Painting: Respective Contractor will provide prime painting on all ferrous metals such as supporting steel or hangers for mechanical piping and equipment. Piping itself is not to be primed. Any finish painting required, including painting of all mechanical items exposed to outside environment will be painted by Respective Contractor.

C. Roof Openings: required by Mechanical Contractor shall be cut by Respective Contractor. Mechanical Contractor is responsible for correct size and location of same.

D. Roof Curbs and Bases: for roof mounted mechanical equipment shall be furnished and anchored to structure by Respective Contractor.

E. Flashing: for roof curbs and bases shall be furnished by Respective Contractor.

F. Counter flashing for roof curbs and bases shall be furnished by Respective Contractor.

G. Sanitary Vent Lead Pans and Flashing: by Respective Contractor.

H. Louvers: furnished by Respective Contractor. Size and location verified by Respective Contractor.

I. Pads and Foundations: for mechanical equipment shall be formed and poured by Respective Contractor. The Respective Contractor shall verify pad sizes, locations and all anchoring devices.

J. Penetrations: holes required for piping or ductwork shall be cut in field at expense of Respective Contractor. Engineer shall give approval prior to any cutting.

K. Holes required for piping or ductwork shall be installed as walls are erected at the expense of the Respective Contractor. Mechanical Contractor to coordinate location and size of all openings prior to building erection or he will assume all costs for providing openings.

L. Penetrations through Structure: Respective Contractor shall cut openings through structure unless otherwise indicated by others on structural drawings. Engineer shall give approval prior to cutting.

M. Excavating and Backfilling: for mechanical work shall be by Respective Contractor.

N. Outside Downspouts: shall be by Respective Contractor. Downspouts shoe shall be by Respective Contractor.

O. Caulking of all plumbing fixtures shall be by Mechanical Contractor.

P. All fire stopping of mechanical penetrations by Respective Contractor.

Q. All caulking of mechanical penetrations through interior partitions by Respective Contractor. All sleeve seals for mechanical penetrations through exterior below grade penetrations by Mechanical Contractor.

R. Mechanical Contractor will install all taps, control valves and thermowells in piping for all temperature sensors, flow switches, pressure sensors and any other control device installed in piping whether shown or not on the Drawings.

S. Dust Protection:

1. Temporary partitions or barriers required to protect existing building or facilities specifically in areas requiring primarily mechanical work; i.e., cross country pipe, etc., shall be provided by Respective Contractor. Respective Contractor shall coordinate necessity and location of such protection with Owner.
2. Temporary filters and covers for protection of new and existing ductwork, piping, and equipment is required during construction and shall be by Respective Contractor.

T. Pipe identification shall be by Mechanical Contractor as specified in Section 200050.

U. Kitchen Equipment: furnished and set in place by Other Contractor. Rough-in shall be by Respective Contractor. Final connections shall be by Respective Contractor.

V. Temporary Use of Equipment: should it become necessary or desirable to operate any equipment before final acceptance, Owner shall be allowed to do so, ONLY after proper adjustments and trial operation by Contractor specified. Respective Contractor shall be responsible for instructing Owner, or his Representative, as to proper operation and care of equipment so used. If equipment is used prior to final acceptance of job, date of first usage will begin warrantee period.

W. All electrical control wiring between mechanical equipment (i.e., air cooled chiller and condensing unit, respective indoor and outdoor equipment, etc.) shall be by Respective Contractor. Conduit and wiring requirements shall adhere to those specified in Division 26.

X. Cutting and Patching: Respective Contractor shall cut and patch finished areas as required by Mechanical Contractor.

Y. Wall Sleeves in new construction for Mechanical systems shall be provided by the Respective Contractor and coordinated by Mechanical Contractor.

Z. Wall Sleeves in existing construction shall be provided and installed by the Respective Contractor.

AA. Ceiling and Wall Access Panels: shall be located by mechanical contractor and installed by Other Contractor.

1.13 EQUIPMENT WARRANTY AND EARLY EQUIPMENT STARTUP

A. Contractor shall provide a complete warranty for all equipment, controls, etc. that includes parts and labor, any equipment that fails shall be repaired and/or replaced at no cost to owner.

B. The warranty shall start on the date of substantial completion. On projects with multiple phases, the date of substantial completion of the final phase shall be the date that the warranty starts for all phases, i.e. the entire project. No exceptions.

C. If special extended warranties exist, they will be noted in the respective sections. Extended warranty starts on the date of Substantial Completion of the final phase, unless another date is agreed to by all parties.

D. If equipment startup is required to provide suitable climate conditions for carpentry finish trim, painting, ceiling tile installation, etc., then this contractor is responsible for starting, operating equipment and providing an extended warranty.

E. Respective Contractor shall provide and change temporary filters over ductwork openings or grilles connected to air handling equipment operated prior to Owner occupancy and Substantial Completion for temporary heating and cooling. Respective Contractor shall submit equipment and ductwork dust protection measures prior to installation of equipment and ductwork.

F. Some devices such as Control Valves, VFD's, etc. require extended warranties. Extended warranties are noted in the Specification Section for that piece of equipment. The prime Contractor shall be responsible for all implementation and cost of extended warranty work.

1.14 MATERIAL AND EQUIPMENT TRANSPORT

A. All material and equipment, shipped to site, shall be suitably covered and protected during shipment to site.

B. Protection shall include shrink wrapping and desiccant bags for humidity controls.

C. Protect equipment from weather, road salts, road dirt, condensation, damage and all other situations that can be detrimental to the condition of the equipment and material being shipped.

D. Engineer will not be on site during delivery; however, Engineer reserves the right to reject material or equipment after the fact that is delivered to site in unsatisfactory condition.

1.15 MATERIAL STORAGE

A. Provide suitable protection from weather and vandalism for all materials and equipment to be installed. Storage shall be dry, clean and safe. Provide heat as required to stop condensation. Condensation occurs during periods of large ambient temperature swings, i.e. spring or fall. Any materials or equipment damaged, deteriorated, rusted or defaced due to improper storage shall be fully repaired, refinished or replaced, as directed by Engineer at no additional cost.

PART 2 - PRODUCTS

2.1 PRODUCT AND MATERIAL APPROVAL

A. A Specification followed by one or more manufacturers is limited to those manufacturers. Names of other manufacturers may be submitted for approval, to the Engineer, a minimum of ten calendar days prior to receiving bids. Approval will be issued by Addendum if approval is granted.

B. The mechanical equipment shall be new, listed by UL and shall confirm to NEMA requirements.

C. If changes in pipe, ductwork, conduit, wiring, structural support, ceiling space, etc. are required as a result of the contractor's decision to purchase equipment with a different arrangement than shown on the Drawings, the Contractor shall be responsible for including all associated costs in their bid. Manufacturers listed on schedules shall be considered "Basis of Design" (BOD). Note that manufacturers listed as equals may have physical characteristics such as weight, footprint, sound levels, electrical, etc., which require more coordination, piping, wiring, and/or general construction changes. The Mechanical Contractor will be responsible for all additional costs associated with the installation of this equipment. Contractors should seek clarification prior to bid for any equipment that does not meet or exceed the scheduled or specified characteristics.

D. Manufacturers listed for products and equipment does not imply that their standard construction or configuration is acceptable or meets the specifications. Equipment proposed "as equal", must meet the specifications including all architectural, mechanical, electrical, and structural details, all scheduled performance and the job design, plans and specifications.

PART 3 - EXECUTION

3.1 PROTECTION AND TREATMENT OF PROPERTY

A. Repair and replace all property damaged in installation of underground lines to meet approval of Owner and authorities having jurisdiction.

B. Repair streets, which are part of State Highway System to satisfaction of State Highway Department.

C. Replace base and wearing surfaces of streets with same kind and thickness of material as existing. Replace brick, concrete and asphalt surface to width 6" wider than disturbed area. Replace entire surface if more than 30% has been disturbed.

D. Replace sidewalks, curbs, gutters, driveways, with same kind and thickness of material. Replace entire section of concrete walks or driveways.

E. Re-grade and replant lawn areas.

F. Protect existing utilities. Cap existing utilities that are abandoned.

G. All property in existing facilities that is damaged/removed, by contractor operations shall be repaired/replaced to previous operating and appearance condition.

3.2 DEMOLITION AND REMOVAL OF EQUIPMENT

A. Contractor shall remove all equipment, hangers and support for portion of mechanical system in present building as indicated on Drawings and/or implied by nature of the work to be removed. Contractor shall remove all pipes and ductwork back to source made obsolete by removing equipment unless specifically instructed otherwise.

B. Contractor shall properly support remaining portions of the work. Contractor shall provide valves, plugs, vents, etc. as required so existing systems remain operational.

C. Owner shall have first right of refusal on all equipment, piping, etc., being removed. If owner decides to keep removed items, then the contractor shall move items to a location on this project site as directed by owner.

D. Openings remaining after equipment has been removed shall be patched to match surrounding surfaces and in conformance with good practice.

3.3 ELECTRICAL CONNECTIONS TO EQUIPMENT AND CONTROL WIRING

A. All electrical work shall be done in accordance with the latest edition of the National Electric Code.

B. All above ground wiring shall be installed in metallic conduit with a minimum conduit size of ¾ inch. All wiring shall be concealed, except in equipment rooms, crawl spaces, tunnels and mechanical or electrical closets. Conduit shall be fastened securely at regular intervals and shall be run parallel to the building lines.

C. Running low voltage wire above bar joist in roof/floor metal deck flutes is not permitted. Wire to be run above bottom chord of truss and fastened to structure with wire ties at maximum 4’-0” o.c.

D. All flexible conduits shall not exceed 2’-0”.

E. All below ground wiring shall be installed in rigid conduit with minimum size of ¾”. Conduit system shall be sealed watertight.

F. Provide all wire, conduit, fittings, miscellaneous materials and labor as required for mounting and connecting the electrical control devices furnished in this contract.

G. All wiring shall be continuous from point to point. No splicing between terminations allowed.

H. In the event that a Supplier of equipment requires a larger starter, disconnect wiring conduit, etc. than those indicated in Contract Documents, he shall reimburse Contractor supplying these items for the difference.

I. Connections and wiring diagrams shown on Drawings or described in Specifications are typical and for bidding purposes only. Detailed diagrams and instructions shall be provided by Contractor supplying the equipment. If connections are different from those shown on Drawings, Mechanical Contractor shall reimburse Electrical Contractor for those differences.

J. Additional relays switches, contactors, etc. which may be required for control purposes in addition to those specified and indicated on Drawings shall be provided by Mechanical Contractor.

K. In the event that several pieces of mechanical equipment from different Suppliers are combined in one system, Mechanical Contractor shall furnish complete wiring and control diagrams to enable Electrical Contractor to make proper connections. Diagrams shall be submitted to Engineer for review, prior to actual wiring.

L. Mechanical Contractor shall furnish to Electrical Contractor written notice of approval and acceptance for all control wiring installed for mechanical systems by Electrical Contractor. Such approval shall be given within 30 days of completion of all such control wiring. Two copies of letter shall be sent to Engineer.

3.4 ATTACHING TO BUILDING CONSTRUCTION

A. Equipment and pipe supports shall be attached to structural members (beams, joists, etc.) rather than to floor or roof slabs. Support from structural members shall be in accordance with manufacturer recommendation of structural member and/or approved by Structural Engineer.

B. Where piping is suspended from structural steel building framing or supporting members, furnish and install beam clamps for attaching piping support device to building member.

C. Obtain approval from Engineer before cutting or welding to structural member or before hanging heavy equipment.

D. Support piping and ductwork from structure so that equipment connections are not being used for support.

3.5 ROUGH-IN

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

B. Refer to shop drawings for equipment rough-in requirements.

3.6 MECHANICAL INSTALLATIONS

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

1. Keep all major equipment covered, in buildings, until major dust producing activities are complete. Equipment to be covered includes chillers, pumps, VFD's and AHU's.
2. All equipment must be installed such that maintenance and service may be properly accomplished. If necessary, the Owner, at their option, may require the contractor to demonstrate the service on any piece of equipment to determine sufficient service space exists. If the service space is not adequate, the equipment shall be relocated at no additional cost to the Owner such that sufficient service space is achieved.
3. Coordinate mechanical systems, equipment, and materials installation with other building components.
4. Verify all dimensions by field measurements.
5. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
6. 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.
7. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
8. Where mounting heights are not detailed or dimensioned, install systems, material, and equipment to provide the maximum headroom possible.
9. 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.
10. Install systems, materials, and equipment to conform with engineer reviewed submittal data. 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 Architect/Engineer.
11. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
12. 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.
13. Extend grease fittings to an accessible location.
14. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at specified slope.
15. All shutdowns required to connect to existing systems shall be scheduled and coordinated with the Owner. Contractor shall prefabricate and install new materials as much as possible to keep shutdown duration to a minimum.
16. All pipe, duct and mechanical equipment shall be installed as high above floor (close to structure) as possible. When any pipe, duct or mechanical piece of equipment is installed lower than 7'-0" above finished floor, foam type insulation with black and yellow caution marker tape shall be installed on bottom leading edges.
17. Contractor shall field verify all locations, sizes and connection points to existing piping, ductwork and systems as shown on the drawings. Contact Engineer with any discrepancies.
18. Provide all contact information to Test and Balance Contractor 30 days prior to start-up of equipment.
19. Contact Test and Balance Contractor after leakage and pressure test on air and water systems has been successfully completed.

B. Platforms and Supporting Stands

1. Each piece of equipment or apparatus suspended from ceiling or mounted above floor level shall be provided with suitable structural support, platform or carrier, in accordance with best recognized practice.
2. Contractors shall exercise extreme care that structural members of building are not overloaded by such equipment. In all cases, details of such hangers, platforms and supports, together with total weights of mounted equipment, shall be approved by Engineer.

C. Drive Guards

1. All belt-driven equipment shall have belt guards with provisional slot for tachometer reading access at shaft. All rotating equipment and drives shall have safety guards.

3.7 CLEANING AND TOUCH UP

A. All mechanical equipment, cabinets, control panels and other enclosures shall be cleaned and have paint touched up as necessary to duplicate factory finished appearance. Touch up paint shall exactly match color, composition and quality of factory applied finish.

B. Equipment furnished with factory applied finish shall be protected from damage by the installing Contractor. Any damaged surface shall be repaired or replaced by the installing Contractor to match original finish or shall be replaced before final acceptance.

3.8 GENERAL COMPLETION, STARTUP

A. Work Included: furnish materials and labor required to perform startup of equipment and systems installed on project and provide operating instructions to Owner.

B. It is Mechanical Contractors' responsibility to conduct an owner orientation meeting which will review all systems, their operation and operation of all equipment.

C. General Requirements.

1. Inspect bearings for cleanliness and alignment and remove any foreign materials found. Grease as necessary and in accordance with manufacturer's recommendations. Replace bearings that run rough or noisy.
2. Adjust tension in V-belt drives, adjust vari-pitch sheaves and drives for proper equipment speed. Change belts and sheaves if necessary to obtain proper equipment speed; remove any foreign materials from sheaves or belts before starting operations; adjust drives for alignment of sheaves and v-belts. Construe proper speed as that which produces intended performance. Change sheaves so that design CFM is achieved when VFD is at 100%. Slowing VFD to meet maximum design CFM is not acceptable.
3. Tighten flanges and packing glands after system has been placed in operation. Replace gaskets in flanges that show any signs of leakage after tightening.
4. Inspect screwed joints for leakage and remake each joint that appears to be faulty. Do not wait for rust to form. Clean threads on both parts, apply compound and remake joint.

5. Adjust pipe hangers and supports for correct pitch and alignment.
6. Flush systems and clean all strainers. After 30 days of operation clean strainers again.
7. Provide such continuing adjustment services as is necessary to ensure proper functioning of all mechanical systems after building occupancy and during guarantee period.
8. Provide duct stiffeners, air straighteners, or turning vanes as required to stop any oil canning, drumming or fan surge to the satisfaction of the engineer.

3.9 AIR FILTERS

A. Provide a total of three (3) sets of air filters for each piece of equipment (AHU's, RTU's, VUV's, CUH's, FC's BC's, etc.) for Owner use after Substantial Completion has been awarded.

B. Never operate equipment without air filters. Contractor shall provide and change air filters, as needed during construction for equipment operation prior to Substantial Completion.

C. Replace temporary construction air filters in each and every piece of equipment within 2 weeks after substantial completion. Testing and Balancing shall not commence until fitter has been changed within respective equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this and all Sections of Divisions 20, 21, 22 and 23.

1.2 SUMMARY

A. Provide equipment, materials, labor and services common to more than one section of Divisions 20, 21, 22 and 23. The work generally includes, but is not limited to the following:

1. Vibration Isolators
2. Electric Motors
3. Pressure Gauges
4. Thermometers
5. Separable Sockets
6. Pressure and Temperature Test Plugs (Pete's Plugs)
7. Sleeves
8. Firestop Sealants and Caulks
9. Mechanical Sleeve Seals
10. Elastomeric Joint Sealants
11. Pipe Identification
12. Mechanical Service Color
13. Equipment Identification
14. Paint
15. Concrete
16. Ceiling and Wall Access Panels
17. Thermostats and Sensors
18. Roof & Wall Penetrations

1.3 SUBMITTALS

A. If specified products are provided, submittals are not required for products provided in this section.

B. If it is desired to use products that are not specified, then those products must be submitted for review prior to ordering said products.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. General: Mount equipment on isolators as noted in Schedule of Usage and as noted in specific specification sections. Isolators shall be furnished by manufacturer of isolators. They shall be engineered for specific piece of equipment.

1. Manufacturers:

a. Mason Industries, Inc.
b. Kinetics Noise Control, Inc.

B. Types of Isolators

1. Neoprene Pad: Cross ribbed pad 3/8" thick.
2. Cork Rib Pad: 1" thick laminated pad consisting of cork bonded between 2 layers of ribbed neoprene. Vibration Mountings Cork Rib Pak.
3. Steel Spring Mounting: Steel housing containing steel springs with top plate, leveling bolt, snubber fastening slots and neoprene pad bonded to bottom.
4. Rubber in Shear Hanger: Neoprene single or double deflection as required.
5. Spring Type Hangers: Deflection to 2".
6. Combination Spring and Rubber in Shear Hangers: Deflection to 2 1/2".

C. Submittals shall show frequency, required efficiency and designed deflection.

D. All vibration isolators shall be selected at 95% efficiency.

E. Schedule of Usage.

1. Blower Unit Heater: Rubber in shear hangers.
2. Central Station Air Conditioners: Internally Spring Isolated.

2.2 ELECTRIC MOTORS

A. Service:

1. Constant Speed Motors: PREMIUM-EFFICIENCY, NEMA Design B, Class B insulation, nameplated and designed for electrical characteristics noted on Drawings in accordance with NEMA and IEEE Standards.
2. Variable Speed Motors: PREMIUM-EFFICIENCY, NEMA Design B, drive rated with Class F insulation, nameplated and designed for electrical characteristics noted on Drawings and in accordance with NEMA and IEEE Standards. All end plates shall be cast iron. Aluminum end plates are not acceptable.

a. Variable speed motors shall include installation of a maintenance free, circumferential, conductive micro-fiber shaft grounding brush to divert shaft currents to ground. Aegis model SGR or approved equal.

b. Variable speed motors shall be in compliance with NEMA MG1-2006, Part 31, Section 4.4.2 as pertains to voltage spikes. (This is to help prevent premature motor winding failures when there is a long cable distance between VFD and motor).

B. General: Motor shall be at least HP specified.

C. Bearings: Ball, sleeve or roller bearings with dustproof rings.

D. Temperature Rise: Continuous rating at 104ºF (40ºC) above ambient.

E. Base: Cast iron or steel with adjustable slide rail.

F. Rating: Motors specified for voltage of 220 to 240 volts and 440 to 480 volts shall have 230/460 rating. Motors specified for voltage of 208 volts shall be designed and nameplated for 200 volts.

G. Enclosures:

1. Hazardous Locations:

a. Explosive Liquid Vapor and Gasses: Class I Explosion Proof.
b. Combustible Dust (i.e., Coal, grain flower:): Class II - Dust Ignition Resistant.

2. Outside: Totally Enclosed Fan Cooled (TEFC).
3. All others: Open Drip-Proof (ODP) unless noted otherwise with a specific piece of equipment.

NEMA Premium™

Product Scope and Nominal Efficiency Levels

The NEMA Premium™ efficiency electric motor program scope is single-speed, polyphase, 1-500 horse-power, 2, 4 and 6 pole, squirrel cage induction motors, NEMA Design A or B, continuous rated. Products must meet or exceed the nominal energy efficiency levels presented below:

Table 1
Nominal Efficiencies for "NEMA Premium™" Induction Motors
Rate for 600 Volts or Less (Random Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5

7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1

H. Sizing:

1. Select motors to have required capacity to operate driven equipment under all conditions of operation without overload.
2. Do not include motor service factor when determining motor size.

I. Manufacturers:

1. Allis Chalmers
2. General Electric
3. Louis Allis
4. Reliance
5. Westinghouse
6. Century
7. Marathon
8. Baldor

2.3 PRESSURE GAUGES

A. Accuracy ASME/ANSI B40.1 Grade 1A (1%).

B. 6" minimum diameter dial, stainless steel bourdon tube, lower connection.

1. Manufacturers:

a. Ashcroft 1379S
b. Hellicoid 440

c. U.S. Gauge 1600
d. Duro United Series #10
e. Weksler 300 Series
f. Trerice No. 4500 Series
g. McMaster-Carr. High-Accuracy

C. Pressure Snubbers: Piston type like WEKSLER RS1.

2.4 THERMOMETERS

A. Provide and install light powered digital thermometers to meet the following criteria.

1. Display: 3/8" LCD digits
2. Accuracy: 1%
3. Range: -40/300°F
4. Humidity: Operational in ambient conditions up to 100% RH.
5. Case: High impact
6. Stem length to fit separable sockets. Reference separable sockets for required length.
7. Adjustable joint mounting so head can swivel and rotate for best visibility.
8. Heads shall be replaceable without any loss of water from system.

B. Manufacturers:

1. Weiss Vari-angle digital thermometer
2. Trend Instruments Inc.
3. Winters 9IT
4. Trerice

2.5 SEPARABLE SOCKETS

A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.

1. Material: Brass, for use in copper piping.
2. Material: Stainless steel, for use in steel piping.
3. Material: Steel, for use in steel piping
4. Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation. Omit extension neck for sockets in piping not insulated.
5. Insertion Length: To extend to a minimum of 1/3 (one-third) of diameter of pipe.

2.6 PRESSURE AND TEMPERATURE TEST PLUGS (PETE'S PLUGS)

A. Plug shall be brass or stainless steel arranged for a 1/8" diameter shaft to enter into the plug. The plug shall be rated for 350°F for water and 200°F for gases. The plug shall be equipped with a pipe cap. The plug system shall be rated for zero leakage to 250 PSIG.

B. Manufacturer:

1. Sisco
2. Trerice
3. Peterson Equipment

2.7 SLEEVES

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

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

C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

D. Sleeves shall be in accordance with the schedule unless otherwise specified.

PIPE SIZE	UNINSUL.	1" INSUL.	1-1/2" INSUL.	2" INSUL.
1"	2	4	6	6
1-1/2"	3	4	6	8
2"	3	6	8	8
3"	4	6	8	10
4"	6	8	10	10
6"	8	10	12	12
8"	10	12	12	14

2.8 FIRESTOP SEALANTS AND CAULKS

A. Penetration Sealant:

1. 3M Brand “Moldable Putty Pads and “Moldable Putty Stix”.
2. 3M Brand “Fire Barrier” Caulk, Putty or Penetrating Sealing Systems.
3. Dow Corning “Fire Stop Foam” and “Fire Stop Sealant” systems.
4. Insta-Foam Products, Inc. “Insta-Fire Seal Silicone RTV Foam”.
5. Standard Oil Engineering Materials Company “Fyre Putty”.

B. Intumescent Sealant:

1. 3M Brand “Fire Barrier” caulk or putty, FS-195 Wrap Strip and CS-195 Composite Sheet.
2. Dow Corning “Fire Stop Intumescent Wrap Strip”.
3. Fox Couplings, Inc. “The Fox Cast-in-Place Coupling”.
4. For plastic pipe penetrations up to 4” diameter: Use 3M pre-manufactured fire barrier plastic pipe devices or equal.
5. For plastic pipe penetrations larger than 4” diameter: Use 3M fire barrier RC-1 restricting collar with FS-195+ wrap/strip or equal.

C. Performance Characteristics: Firestopping materials shall conform to both Flame (F) and Temperature (T) rating as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests.

1. F Rating shall be a minimum of one hour but not less than the fire resistance rating of the assembly being penetrated.
2. Conduct the fire test with a minimum positive pressure differential of 0.01" of water column.

D. Quality Assurance: Installer qualifications – firm specializing in firestopping installation with not less than two years of experience or trained and approved by firestopping manufacturer.

2.9 MECHANICAL SLEEVE SEALS

A. Description: Modular design with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

B. Manufacturers: Thunderline/Link-Seal; Calpico, Inc.; MetraFlex Co.

2.10 ELASTOMERIC JOINT SEALANTS

A. Sealant: Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated. Per ASTM C 920 like Dow Corning 995 GE Silicones, Tremco Spectrum 1 or equal.

B. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26ºF (minus 32ºC). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance. Verify compatibility with Elastomeric Joint Sealant Manufacturer prior to use.

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

D. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

2.11 PIPE IDENTIFICATION

A. Labeling shall consist of the following:

1. Pipe identification to comply with ASME A13.1.
2. Identification of medium in pipe using all uppercase letters.
3. Arrow indicating direction of flow.

PIPE DIA.	SIZE OF LETTERS
3/4" – 1 3/8"	1/2"
1 1/2" – 2 3/8"	3/4"
2 1/2" – 6"	1 1/4"
6" – 7 7/8"	1 1/4"
8" – 10"	2 1/2"
Over 10"	3 1/2"

2.12 PLASTIC LAMINATE SIGNS FOR EQUIPMENT IDENTIFICATON

A. ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore.

1. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
2. Punch for mechanical fastening.
3. Thickness: 1/8 inch (3.2mm) , unless otherwise indicated.
4. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
5. Nomenclature: Name and plan number as shown on Equipment Schedules and on Drawings or as directed by the Owner.
6. Size: Approximate 2 1/2 by 4 inches (65 by 100mm) for control devices, dampers, and valves; and 4 1/2 by 6 inches (115 by 150 mm) for equipment.

2.13 PAINT

A. Sherwin-Williams "TILECLAD II" 2-part epoxy, color: gray or white.

2.14 CONCRETE

A. Concrete shall be 1 part Portland cement, 2 parts sand and 4 parts gravel or broken stone that will pass through a 1" diameter hole. Clean sharp sand, washed gravel and Portland cement, Atlas, Alpha, LoneStar, Universal or approved equal, shall be thoroughly mixed in a dry condition until color of mixture is uniform. This mixture shall be uniformly spread and gravel evenly distributed thereon, then wet and thoroughly mixed to a consistency that will need no tamping but can be easily faced for spading. Hand mixed concrete shall be prepared upon substantially constructed, tight bottom platforms and shall be mixed in batches not to exceed 1 cubic yard per batch. If concrete is machine-mixed, it shall not be mixed until same can be immediately placed. No concrete which has taken initial set shall be used.

2.15 CEILING AND WALL ACCESS PANELS

A. Plastered Wall or Ceiling: 24" x 24" unless otherwise noted. Constructed to receive plaster to match adjacent finish. Milcor Style DW with cam latch.

2.16 THERMOSTATS AND SENSORS

A. Refer to individual equipment specifications and temperature controls specifications for device specifications.

2.17 ROOF AND WALL PENETRATIONS

A. Roof penetration “Roof Vault” by Roof Penetration Housings, LLC. or approved equal.

B. Wall penetration “Wall Vault” by Roof Penetration Housings, LLC. or approved equal.

PART 3 - EXECUTION

3.1 PRESSURE GAUGES

A. Connection in Piping: provide spare pressure snubbers and install ahead of each gauge to minimize gauge needle pulsations as directed by Engineer. Install 1/2" ball valve to isolate each gauge. Mount gauges for maximum visibility from floor.

B. Where gauges are installed across pumps to measure differential pressure, install two (2) 1/2” ball valves, one in pipe from pump suction and one in pipe from pump discharge.

C. Install siphons on all steam gauges: brass or steel.

D. Scale Ranges

1. Domestic Water: 0-150 psig

3.2 THERMOMETERS

A. Connection in piping

1. Mount sockets in vertical up position to facilitate their being filled.
2. Mount and adjust thermometers so they may be read standing on floor without using ladder or straining back.

3.3 PRESSURE AND TEMPERATURE TEST PLUGS (PETE’S PLUGS)

A. Install Pete’s Plugs at each and every piece of hydronic equipment including coils, heat exchangers and pumps and install where shown on Drawings.

B. Install Pete’s Plugs in 1/4" plugged bosses at pump suction and pump discharge flanges.

C. Always install Pete’s Plugs on equipment side of balance valves to measure true differential pressure across equipment, and not across balance valve.

3.4 ESCUTCHEONS

A. Escutcheons: Manufactured wall, ceiling and floor plates; deep-pattern of type required to conceal protruding fittings and sleeves.

1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
2. OD: Completely cover opening and sleeve.

B. Cast Brass: One piece, with set screw.

1. Finish: Rough brass.
2. Finish: Polished chrome-plate.

C. Cast Brass: Split casting, with concealed hinge and set screw.

1. Finish: Rough brass.
2. Finish: Polished chrome-plate.

D. Install pipe escutcheons for exposed pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
2. Un-insulated Piping Wall Escutcheons: Cast brass or stamped steel, with chrome-plated finish and set screw.
3. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.

3.5 SLEEVES / PENETRATIONS

A. Sleeves are not required for core drilled holes through poured in place concrete walls.

B. Install sleeves for pipes and ducts passing through masonry walls, fire rated gypsum-board partitions, gypsum-board partitions with dry wall on both wall faces, and concrete floor slabs.

C. Sleeve length to be a minimum of 1” longer on each side of wall penetration.

D. Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast iron sleeve fittings below floor slab as required to secure clamping ring.

E. Build sleeves into new walls and slabs as work progresses.

F. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

1. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
2. Steel, Sheet-Metal Ductwork Sleeves: For ducts 6 inch and larger, penetrating gypsum-board partitions.

3. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

G. Where sleeves are to be installed in existing floor or masonry wall, seal space between sleeve and wall with non-shrink grout.

H. Above Grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.

I. Below Grade Exterior-Wall Penetrations and Floors of Mechanical Spaces: Seal penetrations using mechanical sleeve seals. Size penetration for 1-inch annular clear space between pipe and opening for installing mechanical sleeve seals.

1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

J. Fire-Barrier Penetrations:

1. Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe and duct penetrations. Seal penetrations with fire sealants and caulks.
2. This assembly must maintain a watertight seal between floor or wall and pipe when used on exterior walls, or floors of wet areas. Also use mechanical link seals in these cases.
3. Use intumescent sealant for applications where combustible penetrants are involved (i.e., insulated or plastic pipe).
4. Install in all penetrations where required by code.

K. Sealant Application

1. Install sealants around all piping and duct penetrations.
2. Comply with sealant manufacturer’s written installation instructions for products and applications indicated, unless more stringent requirements apply.
3. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of sealants as applicable to materials, applications, and conditions indicated.
4. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
5. Install sealant backings of type indicated to support sealants during applications and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

    a. Do not leave gaps between ends of sealant backings.
    b. Do not stretch, twist, puncture, or tear sealant backings.

6. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

    a. Place sealants so they directly contact and fully wet joint substrates.
    b. Completely fill recess between pipe and opening.

c. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
d. Remove excess sealants from surfaces adjacent to joint.
e. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of product in which joints occur.

3.6 PIPE IDENTIFICATION

A. Install Pipe Identification on each system. Include pipe service as abbreviated on Drawings i.e. CHWS, CHWR, etc. and arrows showing normal direction of flow.

1. Plastic markers, with application systems. Install on insulation segment of required for hot, un-insulated piping.

2. Locate pipe identification as follows:

a. Exposed piping in unfinished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, above lay-in ceilings and exterior non-concealed locations.
b. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern or service is not obvious.
c. Adjacent to penetrations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.
d. At access doors, manholes and similar access points that permit view of concealed piping.
e. At all major equipment and other points of origination and termination.
f. Spaced at maximum of 50-foot (15 m) intervals along each run. Reduce intervals to 25 feet (7.5 m) in congested areas of piping and equipment and in equipment rooms.

B. In all cases, Fire Protection and Natural Gas piping shall be painted in its entirety in all exposed areas including unfinished areas. Natural gas piping on roof shall be painted safety yellow in its entirety.

3.7 EQUIPMENT IDENTIFICATION

A. Install engraved plastic-laminate sign on each scheduled piece of mechanical equipment.

1. Lettering Size: Minimum 1/4 inch (6.4 m) high lettering for name of unit if viewing distance is less than 24 inches (610 mm), 1/2 inch (12.7 mm) high lettering for distances up to 72 inches (1800 mm) and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principle lettering.
2. Text of Signs: Provide specific name of unit as identified on Equipment Schedule on Drawings or as directed by the Owner. Inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
3. Locate identifying devices as necessary for unobstructed view in finished construction.
4. Where equipment is located above lay-in ceiling, affix a 1” adhesive label on ceiling grid system below equipment with equipment tag identification. Verify description

requirements with Owner/Engineer. Where equipment is located above inaccessible ceilings, affix label or engraved plastic laminate sign securely to or near access panel.

3.8 PAINTING

A. Use paint type and method of application as follows:

1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
6. Exterior, Ferrous Steel Supports: Use semigloss acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
7. Exterior or Interior Ferrous Supports for Cooling Towers, Tank Supports or any Wet or Corrosive Environment: Use epoxy paint.

B. Do not paint piping specialties with factory-applied finish.

C. Adhere strictly to paint manufacturer’s written instructions for application.

D. Damage and Touch-Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

E. Paint the following:

1. All exposed insulated and or uninsulated pipes, equipment, ductwork including insulation, etc. in finished areas.
2. All exposed ventilation equipment and ductwork in finished areas.
3. All equipment located in boiler room or equipment spaces.
4. All exposed bare pipe.
5. All hangers, platforms, supports and miscellaneous steel.
6. All exterior galvanized iron steel surfaces, including cooling towers, rooftop units, piping, ventilators, intake cowls, wall frames, louvers, exhaust vents, boiler stack and other miscellaneous surfaces.
7. All sheet metal pipe enclosures in finished spaces to be painted to match adjacent surfaces.
8. Convector cabinets, fin pipe enclosures and cabinet unit heaters.
9. All supply, return and exhaust grilles painted to match adjoining surfaces.
10. All roof mounted ventilation equipment.
11. All access panels.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit and place miscellaneous metal supports accurately in location, alignment and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, “Structural Welding Code – Steel”.

3.10 CONCRETE HOUSEKEEPING PADS

A. Install housekeeping pads below all equipment located in Mechanical Room.

B. Pads shall be constructed of poured-in-place concrete, Nominal 6" thick (form using standard 2" x 6" lumber) with 1" chamfer on all horizontal edges.

C. Pads shall extend a minimum of 6" beyond equipment in all directions or as detailed on the Drawings.

D. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

E. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

F. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

G. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.11 EXCAVATION AND BACKFILLING

A. Properly support banks of excavation with safety sheet pile. Install barricades, fences, guards, etc. as required for safety and by OSHA.

B. Provide adequate pumping equipment and keep excavation free of water.

C. Excavate pipe trenches to proper depth and slope as required for piping.

D. Pipes passing under or through footings shall be sleeved (minimum two pipe sizes larger than pipe).

E. Pipes passing under or through corrosive fills shall have external coating to protect from corrosion.

F. Support and protect underground piping so it remains in place without settling and without damage during and from backfilling. Replace any piping so settled or damaged. Pipe shall not be supported on blocks to grade.

G. Lay underground piping on 6" bed of sand. Sand to fill from trench bottom to 6" above top of pipe. Carefully fill sand around pipe being sure that there is a complete smooth layer below pipes with no voids.

H. Backfill with clean earth, crushed rock, gravel or sand. Use only sand inside buildings. Fill first two feet in 6" lifts and remainder in 12" lifts. Tamp and puddle each layer.

I. Provide 6" wide marker tape buried directly underground above utility lines continuously along length of pipe. Marker tape shall be a minimum of 12" above utility line. Marker tape shall be a minimum of 6" wide.

J. Replace all surfaces with like, kind, i.e. grass, road, sidewalk, etc., or as specified elsewhere.

3.12 THERMOSTATS AND SENSORS

A. Unless specifically noted otherwise, install all wall-mounted thermostats and sensors required for respective equipment with 48" A.F.F. to top of device box. Closely coordinate rough-in locations with all trades.

3.13 ROOF AND WALL PENETRATIONS

A. Provide pre-manufactured curb or wall box with piping exit seals for moisture tight penetrations. Do not run insulation thru the exit seals. Exit seals to seal tight to carrier pipe.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section specifies piping, valves and fittings including piping support for all systems. These systems include the following:

1. System Piping Schedule #11, #11A
   Refrigeration
   R-410A

2. System Piping Schedule #13
   Coil Condensate
   Drip Waste

3. System Piping Schedule #14
   Sanitary Inside Building
   Vent Inside Building

4. System Piping Schedule #17
   Domestic Hot Water Aboveground
   Domestic Cold Water Aboveground

5. System Piping Schedule #19
   Fire Protection

6. System Piping Schedule #20
   Gas Piping

B. All specialty valves for specific systems are listed in specification sections for those systems. Specialty valves for specific systems can be found in the following sections:

1. Plumbing Specialty Valves – 220000 “Plumbing”
2. Fire Protection Specialty Valves – 210000 “Fire Protection”
3. Refrigeration Specialty Valves – 230000
4. Hydronic Specialty Valves – 230000 “Heat Transfer”
5. Control Valves – 230000 “Temperature Controls”

C. Related sections include the following:

1.	200010	Common Work Results for Fire Suppression, Plumbing and HVAC
2.	200050	Common Materials and Methods for Fire Suppression, Plumbing and HVAC
3.	200180	Common Insulation for Plumbing and HVAC
4.	210000	Fire Suppression
5.	Division 22	Plumbing
6.	Division 23	Mechanical

1.3 SUBMITTAL

A. Submit product data for valves and fittings used in each system.

B. Submittal data to be in compliance with Section 200010.

C. Product data shall include pressure and temperature classifications, model numbers, material types, actuators, trim, valve handle extensions and all pertinent data as required for complete evaluation by Engineer.

D. Maintenance data for valves shall include adjusting, servicing, disassembly, exploded view with part numbers and repair instructions.

E. Piping submittals are not required. However, piping to meet all specifications.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

B. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

C. All grooved joint couplings, fittings, valves and specialties shall be products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

D. Welded and Soldered Pipe

1. Pipe welding shall comply with provisions of latest revision of applicable code, whether ASME Boiler & Pressure Vessel Code, ASTM Code for Pressure Piping, or such state or local requirements as may supersede code mentioned above.
2. A copy of his welding procedure specification together with proof of its qualification as outlined and required by most recent issue of code having jurisdiction.
3. Submit Operator's qualification record in conformance with provisions of code having jurisdiction, showing that operator was under proven procedure specifications submitted by Contractor.
4. Standard procedure specifications and operators qualified by National Certified Pipe Welding Bureau shall be considered as conforming to requirements of these specifications.
5. Welders to have ASME test papers not more than 5 years old.

6. Each manufacturer or Contractor shall be responsible for quality of welding done by his organization and shall repair or replace work not in accordance with these specifications.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set globe and gate valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
3. Stack piping above grade and covered.

C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL DESIGNATIONS

A. Refer to System Schedules in Execution portion of this Section for designation of pipe types to be used for each piping system. When more than one piping type is designated, contractor may choose which type is installed.

B. Piping Designations

1. CP-2 Steel:

a. 3/4" to 2" ASTM A53, Type S (seamless) or Type F (furnace-butt welded) Grade A Black steel (galvanized if so noted). U.S. Steel; Laclede; Republic; Youngstown, Jones & Laughlin.
b. 2-1/2" to 12" ASTM A53, Type E (electric resistance welded) Grade A Black steel (galvanized if so noted).
c. 14" to 20" ASTM A53, Type E (electric resistance welded) Grade B or Type S (seamless), (galvanized if so noted). U.S. Steel; Laclede; Republic; Youngstown; Jones & Laughlin.

2. CP-8 Copper: ASTM B75, B88, B251 and B447; ASA H23.1-1947 seamless copper tubing, hard temper (soft copper if so noted). Type K or L. (as noted) Chase; Bridgeport, Anaconda; Scovill.

3. CP-20 Ductile Iron Mechanical Joint: AWWA C151 with Mechanical Joint Bell and plain spigot end, cast iron pipe, centrifugally cast with asphaltum coating. Class as noted in schedule. Pipe to be marked and carry nominal weights and dimensions as required by state and local codes. As manufactured by James B. Clow & Sons; American Cast Iron Pipe; Alabama Pipe; U.S. Pipe & Foundry.

4. CP-29 Copper ACR – ASTM B-280 seamless copper tubing, hard tempera, 50 ft., soft in coils as noted in schedules. Tubing is cleaned and sealed at the manufacturers. Chase, Bridgepoint, Anaconda, Scovill.

5. CP-30 PVC: polyvinylchloride; ASTM D 1785 schedule as noted. As manufactured by A.M. Byers; U.S. Steel; Carlon, Crescent; **normal or high impact as noted**.

6. CP-33 PVC DWV Drainage Pipe: ASTM D2665, Polyvinylchloride pipe solid-wall, waste, and vent. Schedule as noted.

7. CP-40 Cast Iron (HUB) Bell and Spigot: ASTM A74, extra heavy bell and spigot cast iron soil pipe centrifugally metal or sand spun cast with asphaltum coating. American Brass & Iron; Tyler; Charlotte. Pipe and fittings shall be labeled with the trademark of the Cast Iron Soil Pipe Institute.

8. CP-41 Soil Pipe: Cast Iron no hub ASTM A888, CISPI 301. No hub cast iron soil pipe centrifugally metal or sand spun cast with asphaltum coating. American Brass & Iron; Tyler; Charlotte. Pipe and fittings shall be labeled with the trademark of the Cast Iron Soil Pipe Institute.

2.2 PIPE FITTING DESIGNATIONS

A. Refer to System Schedules in Execution portion of this Section for designation of fitting types to be used for each piping system. Fittings to be of the same strength of piping in each respective piping system. When more than one type is designated, contractor may choose which type is installed.

B. Fitting Designations:

1. CF-1 Malleable Iron: ASME B16.3. 300# (or as noted) black band malleable iron threaded fitting (galvanized if so noted). Flagg; Kuhns; Illinois Malleable, Stockham, Anvil.

2. CF-2 Cast Iron: ASME B16.4; 250# (or as noted) black cast iron threaded fitting (galvanized if so noted). Kuhns, Illinois Malleable; Stockham; Anvil.

3. CF-5 Wrought Steel fittings: ASTM, B16.9, B16.11, B16.28. Steel butt welding fitting. All elbows shall be long radius, unless otherwise noted. Tube Turns; Midwest; Taylor Forge; Ladish; NIBCO; Grinnell; Weld Bend; Babcock Wilcox.

4. CF-6 Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 (ASTM A 47M), Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings. All fittings shall be long radius unless otherwise specified. UL listed, FM approved for fire service. Victaulic; Anvil; Gruvlok.

5. CF-8 Wrought Copper: ASME B16.22. Wrought copper solder joint fitting as manufactured by Flagg; Mueller; Chase, NIBCO; Anaconda; American Brass.

6. CF-8A Wrought Copper Cold Press Fitting: Fitting specifically design to be field installed with hand held portable press tool. Fitting to be certified by NSF, UL and be compliant with ICC, UPC, PHCC, NFPA13, 13D and 13R. Fittings to be ProPress Smart Connect installed by RIGID Portable Press tool.

7. CF-20 Mechanical Joint: AWWA C111 ductile or grey-iron, standard pattern, same class as noted for pipe. Alabama Pipe, U.S. Pipe & Foundry.

8. CF-30 PVC: Polyvinylchloride; same schedule and impact as noted. Schedule 40 ASTM D 2466 Socket Type, Sch 80 ASTM D 2467 Socket. Carlon; Crescent; A.M. Byers; U.S. Steel; Chemtrol.

9. CF-33 PVC Drainage Fittings: ASTM D2665, socket type, made to ASTM D 3311 drain waste and vent patterns.

10. CF-40 (HUB) Bell and Spigot: Cast iron bell and spigot Type fitting DWV configuration, extra heavy duty. American Brass & Iron; Tyler; Charlotte.

11. CF-41 (NO-HUB) Mechanical Joint: Cast iron no hub type fitting - DWV configuration. American Brass & Iron; Tyler; Charlotte.

2.3 PIPE JOINT DESIGNATIONS

A. Refer to System Schedules in Execution portion of this Section for designations of joint types to be used for each piping system. When more than one type is designated, contractor may choose which type is installed.

B. Piping Joint Designations:

1. CJ-1 Threaded: threads shall conform to ASME B1.20.1, ASTM B16.3, B16.4, B16.12. Remove all burrs. Ream pipe ends to full bore and remove all chips. Use pipe compound on male ends only. Approved pipe compounds: Blue Seal; Key Tite.

2. CJ-5 Welded Pipe: standard specification provision for fabrication and erection of piping systems as recommended by National Certified Pipe Welding Bureau. All welding of pipe, regardless of condition of is to be installed as follows:

a. Pipe welding shall comply with provisions of latest revision of applicable code, whether ASME Boiler & Pressure Vessel Code, ASTM Code for Pressure Piping, or such state or local requirements as may supersede code mentioned above.
b. A copy of his welding procedure specification together with proof of its qualification as outlined and required by most recent issue of code having jurisdiction.
c. Submit Operator's qualification record in conformance with provisions of code having jurisdiction, showing that operator was under proven procedure specifications submitted by Contractor.
d. Standard procedure specifications and operators qualified by National Certified Pipe Welding Bureau shall be considered as conforming to requirements of these specifications.
e. Welders to have ASME test papers not more than 5 years old.
f. Each manufacturer or Contractor shall be responsible for quality of welding done by his organization and shall repair or replace work not in accordance with these specifications.

3. CJ-6: grooved mechanical-joint couplings: Two ductile or iron housing segments and synthetic rubber EPDM (+250^{o}F) gasket of central cavity pressure-response design; with ASTM A449/ASTM A183 nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings; Installation-Ready rigid coupling, or equal by Victaulic, Gruvlok, or engineer approved equal. UL classified in accordance with ANSI / NSF-61 for potable water service and shall meet the low-lead requirements of NSF-372. Torque of fittings, if required, shall be in accordance with the manufactures latest recommendations and each coupling shall be tagged or marked with the specific value of torque attained to confirm joint rigidity and proper installation, when applicable.

4. CJ-8: 95% tin, 4.85% copper, 0.15% selenium. Premium Contractor Grade solder. 410^{o}F Minimum working temperature; 7130 PSI Tensile Strength, ASTM B32. Like Taramet Sterling, Taracorp. IMACO, Winston-Salem, NC. Cut ends of tubing square with wheel type cutter, ream to remove burrs, wipe clean on inside, apply paste type solder flux on external surface. Apply solder (no lead allowed).

5. CJ-8A: Cold Press connection 0-250°F, 200 psig. Connection made using a hand held portable press system. Joint to be certified by NSF, UL and be compliant with ICC, UPC, PHCC, NFPA13, 13D and 139 like RIGID VIEGA ProPress System.

6. CJ-9 Silver Solder: minimum working temperature of 1100°F (copper to copper) AWS A5.8, Bag1. Make brazed joints in accordance with Section G of Code for Pressure Piping, ASME B16.22. Approved products: Handy Harmon SilFos or United Wire & Supply Phosphon 15. Approved fluxes: Handy Flux or Sil-Flux (lead content shall be .2% or less).

7. CJ-20 Mechanical Joint: AWWA C 111 ductile - or grey – iron glands, rubber gasket and steel bolts. Reinforce joint at hydrants, fittings or valves with heavy wrought iron clamps and wrought iron rods in accordance with standard details of National Board of Fire Underwriters. Apply heavy coat of bituminous solution to assembly.

8. CJ-33 PVC/CPVC

a. Solvent Cement: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1) Comply with ASTM F 402 for safe-handling practice of cleaners, primers and solvent cements.
2) ABS piping: ASTM D 2235 and ASTM D 2661.
3) CPVC Piping: ASTM D 2846 and ASTM F-493.
4) PVC Pressure Piping: ASTM D 2672.
5) PVC Non-pressure Piping: ASTM D 2665.
6) PVC to ABS Non-pressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.

b. Heat Welding: ASTM D 2657
c. Threads: Use only where noted on schedules. Install as outlined for steel pipe but only to be used on Schedule 80 or 120 pipe. Use strap wrench for tightening.

9. CJ-40 (HUB) Bell & Spigot: Gasket-ASTM C 564, Rubber. American Brass & Iron; Tyler; Charlotte.

10. CJ-41 (No HUB) Coupling: Stainless steel couplings CISPI 310 with ASTM A 167, Type 301 or ASTM A 666 Type 301 Stainless steel corrugated shield; stainless steel bands and sleeve. American Brass & Iron; Tyler; Charlotte.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Eslon Thermoplastics.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimension; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thomson Plastics, Inc.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO, Inc.
b. NIBCO, Inc.; Chemtrol Div.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

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

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company/
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300- psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America
e. Anvil/Gruvlok

2.6 UNIONS AND FLANGED CONNECTIONS

A. 150-pound malleable iron with ground joint and brass to iron seats. Crane 1280.

B. 125-pound wrought copper or cast brass union with solder joint fittings. Crane 633.

C. 150-pound forged steel flanges with welding neck. Crane 568.

D. 150-pound bronze flanges with tube stop. Mueller F900.

2.7 VALVE DESIGNATIONS

A. Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.

B. All valves shall be compatible with the type of piping material installed in the system.

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1 Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.

2	VALVE DESIGNATION	CV-4	
3	TYPE	Globe	
4	MAXIMUM WORKING		
4.1	Pressure - PSIG	125	
4.2	Temperature - ºF	Sat. Stm.	
5	SIZE LIMITS - Inches	1/2 - 2 1/2	
6	DESCRIPTION		
6.1	Body	Bronze	
6.2	Trim	Bronze	
6.3	Disc/plug	Renewable Composite	
6.4	Bonnet	Screw-in	
6.5	Stem	Rising-Silicon Bronze	
6.6	Seat	Integral	
6.7	Agency Compliance	MSS SP-80	
	APPROVED PRODUCTS	Soldered	Threaded
7.1	Nibco	S211	T211
7.2	Crane	1310	1

8 NOTES

8.1 Provide manufacturer’s standard stem packing for service intended.

8.2 Valves with rising stems suitable for repacking under pressure.

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1 Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.

2	VALVE DESIGNATION	CV-5
3	TYPE	Globe
4	MAXIMUM WORKING	
4.1	Pressure - PSIG	125
4.2	Temperature - ^{o}F	Sat. Stm.
5	SIZE LIMITS - Inches	3 - 12
6	DESCRIPTION	
6.1	Body	Iron ASTM A126
6.2	Trim	Bronze
6.3	Disc/plug	Renewable Composite
6.4	Bonnet	Bolted
6.5	Stem	OS&Y
6.6	Seat	Renewable Rings
6.7	Agency Compliance	MSS SP-85
7	APPROVED PRODUCTS	
7.1	Nibco	F-718-B
7.2	Crane	351
7.3	Jenkins	613CJ
8	NOTES	

8.1 Provide manufacturer’s standard stem packing for service intended.

8.2 Valves with rising stems suitable for repacking under pressure.

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1 Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.

2	VALVE DESIGNATION	CV-7		CV-8	
3	TYPE	Horizontal Swing Check		Horizontal Swing Check	
4	MAXIMUM WORKING				
4.1	Pressure - PSIG	125		125	
4.2	Temperature - ^{o}F	Sat. Stm.		Sat. Stm.	
5	SIZE LIMITS - Inches	0 - 3		2 1/2 - 12	
6	DESCRIPTION				
6.1	Body	Bronze ASTM-B62		Iron ASTM A-126	
6.2	Trim	Bronze		Bronze	
6.3	Disc/plug	Bronze		Renewable Bronze	
6.4	Bonnet	Screw-in		ASTM B-584	
6.5	Seat	Integral		Renewable Rings	
6.6	Agency Compliance	MSS SP-80		MSS SP-71 TYPE I	
7	APPROVED PRODUCTS	Soldered	Threaded	Threaded	Flanged
7.1	Crane	1342	37	372	373
7.2	Nibco	S41BB	T-413B	T-918-13	F-918-13
7.3	Jenkins	762A			
7.4	Victaulic	Series 716		Series 779	

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1 Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.

2	VALVE DESIGNATION	CV-10	CV-11
3	TYPE	Lubricated Plug Cock	Lubricated Plug Cock
4	MAXIMUM WORKING		
4.1	Pressure - PSIG	200	175
4.2	Temperature - ^{o}F	150	150
5	SIZE LIMITS - Inches	1/2 – 2 (Threaded)	2 1/2 – 4 (Flanged)
6	DESCRIPTION		
6.1	Body	Iron	Iron
6.2	Trim	Iron	Iron
6.3	Disc/plug	100% Pipe Area Plug	100% Pipe Area Plug
6.4	Seat	Integral	Integral
7	APPROVED PRODUCTS		
7.1	Nordstrum	114	142, 143
7.2	Walworth	1700	1796, 1797
8	NOTES		
8.1	Provide manufacturer’s standard stem packing for service intended.		

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1 Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.

2	VALVE DESIGNATION	CV-16		CV-17
3	TYPE	Eccentric Plug		Eccentric Plug
4	MAXIMUM WORKING			
4.1	Pressure - PSIG	125		150
4.2	Temperature - ^{o}F			
5	SIZE LIMITS - Inches	1/2 - 2 (Threaded)	2 1/2 - 4 (Flanged)	5 - 12 (Flanged)
6	DESCRIPTION			
6.1	Body	Iron		Semi-Steel
6.2	Trim	St. Steel		Iron
6.3	Disc/plug	Dezurik Bronze with FS55 (250)		Dezurik Resilient Faced Plug RS55 (250)

7 NOTES

7.1 Provide manufacturer's standard stem packing for service intended.

7.2 Provide lever actuator for each valve except where special actuator is noted on Drawings.

7.3 Where eccentric plug valves are noted on Drawings as balancing valves, they are to have position stop, plastic cap and 1/8" downstream tap.

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1	Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.	
2	CLASS NO.	CV-20
3	TYPE	Ball - Full Port
4	MAXIMUM WORKING	
4.1	Pressure - PSIG	600
4.2	Temperature - ºF	Sat. Stm.
5	SIZE LIMITS - Inches	1/2 – 2 1/2”
6	DESCRIPTION	
6.1	Body/End Piece	2-Piece Construction - ASTM B 584 Bronze Body Alloy 844 Forging Brass ASTM B-124 Alloy 377
6.2	Ball	Chromeplated Brass Full Port
6.3	Stem	Bronze or Brass
6.3.1		Provide with Stem Extension on insulated pipes
6.4	Seats/Seals	Teflon
6.5	Agency Compliance	MSS SP-110
7	APPROVED PRODUCTS	Threaded
7.1	Nibco	T-585-70
7.2	Crane/Capri	9202
7.3	Conbraco Industries, Inc.	70-100
	Apollo Series	
8	NOTES	
8.1	Soldered valves are not allowed.	
8.2	Provide stem extension or valve manufacturers insulated extension handle system on all valves installed in insulated systems and specified to be insulated.	
8.3	Provide lead-free valves for all domestic water applications.	

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1	Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.	
2	VALVE DESIGNATION	CV-21
3	TYPE	Ball
4	MAXIMUM WORKING	
4.1	Pressure - PSIG	125 (200 WOG)
4.2	Temperature - ^{o}F	350
5	SIZE LIMITS - Inches	4 - 10
6	DESCRIPTION	
6.1	Body/End Piece	Cast Iron Split Body A126 CL.B
6.2	Ball	Nickel Plated
6.3	Stem	
6.3.1		Stainless steel blow-out proof
6.3.2		Stem extension for all insulated pipes
6.4	Seats/Seals	Reinforced PTFE
6.5	Agency Compliance	MSS SP-72, FED. SPEC. WW-V-35, ANSI
6.6	Handle	Lever Operated
8	APPROVED PRODUCTS	
8.1	Victaulic	Series 721 (1,000 PSIG WOG Rating)

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1	Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.	
2	CLASS NO.	CV-22
3	TYPE	Ball - Full Port - AGA Gas Ball Valve
4	MAXIMUM WORKING	
4.1	Pressure - PSIG	5 psig Ambient - Valve Rated at 600 psig at 250° F
5	SIZE LIMITS - Inches	1/2 - 2
6	DESCRIPTION	
6.1	Body/End Piece	Cast Brass ASTM B684 - C85700 Forged Brass ASTM B124 - C37700
6.2	Ball	Chromeplated Brass Conventional Port
6.3	Stem	Bronze or Brass
6.4	Seats/Seals	PTFE
6.5	Agency Compliance	
6.5.1	ANSI	Z21.15
6.5.2	FM	1/4" - 2"
6.5.3	UL	MHKZ; YSTD: VOGU (1/2" - 1"); YRBX (1 1/4" - 2"); YRPV (1 1/4" - 2")
7	APPROVED PRODUCTS	Threaded
7.1	McDonald	#10710

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1	Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.	
2	CLASS NO.	CV-23
3	TYPE	Butterfly
4	MAXIMUM WORKING	
4.1	Pressure - PSIG	300
4.2	Temperature - ^{o}F	200
5	SIZE LIMITS - Inches	3 – 6 (see note below)
6	DESCRIPTION	
6.1	Body/End Piece	Duct. Iron ASTM A-126 Threaded Lug for dead end service
6.2	Disc	AL. Bronze ASTM B-148 Alloy 954/955; Coated Ductile Iron
6.3	Stem	416 Stainless steel ASTM A-582 Collar bushings upper and lower bushing Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
6.4	Seats	Pressure Responsive EPDM
6.5	Agency Compliance	MSS SP-67
7	OPERATOR	
7.1	Standard Lever-lock handle w/memory stop **Delete this line if worm gear actuator is used**.	
7.2	**Self-locking worm gear type actuator with adjustable stops and disc position indicator.**	
7.3	**Provide with chain wheel where noted on Drawings.**	
8	APPROVED PRODUCTS	
8.1	Nibco	LD 2000-3
8.2	Crane	14-TL
8.3	Apollo	6L-31
8.4	Lunkenheimer	FIG. 4735
8.5	Stockham	LD-711-BS3-E
8.6	Victaulic	VIC300 Series
9	NOTES	
9.1	Do not use butterfly valves on pipes size 2 1/2” and smaller.	

PART 2 - PRODUCTS (Continued) VALVE SCHEDULES

1 Refer to System Schedules in Execution portion of this Section for designation of valve types to be used for each piping system.

2	CLASS NO.	CV-24
3	TYPE	Butterfly
4	MAXIMUM WORKING	
4.1	Pressure - PSIG	150
4.2	Temperature - ^{o}F	200
5	SIZE LIMITS - Inches	8 - 12
6	DESCRIPTION	
6.1	Body/End Piece	Duct. Iron ASTM A-536 Threaded Lug for dead end service
6.2	Disc	AL. Bronze ASTM B-148 Alloy 954/955; Coated Ductile Iron
6.3	Stem	416 Stainless steel ASTM A-582 Collar bushings upper and lower bushing
6.4	Seats	EPDM Rubber
6.5	Agency Compliance	MSS SP-67
7	OPERATOR	
7.1	Self-locking worm gear type actuator with adjustable stops and disc position indicator.	
7.2	**Provide with chain wheel where noted on Drawings.**	
8	APPROVED PRODUCTS	
8.1	Nibco	LD 2000-5
8.2	Crane	14-TL
8.3	Apollo	6L-31
8.4	Lunkenheimer	FIG. 4735
8.5	Stockham	LD-711-B53-E
8.6	Victaulic	300 Series

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pipe, valves and fittings for each system as designated in the System Schedules on the following pages.

B. Reference Products, Part 2 of this Section for specifications and manufacturers of pipes, valves and fittings designated to be installed in System Schedules.

PART 3 - EXECUTION (Continued)

SYSTEM PIPING SCHEDULE 11
REFRIGERATION
Refrigerants R-22 and R134A

1 Install pipe, valves and fittings as designated in this Schedule for this System.

2	LOCATION	ABOVE GROUND		BELOW GROUND	
3	PIPING DESIGNATIONS	LOW SIDE	HIGH SIDE	LOW OR HIGH SIDE	
3.1	CP-29	3/8” – 4 1/8” 1/8”	3/8” – 4	Note 4.1	
	CP-8	K 5”-12”			
	CP-8	K	5” – 12”	3/8”-12”	
3.2	Fittings	Wr. Copper	CF-8	Wr. Copper	CF-8
3.3	Joints	Silver Brazed	CJ-8	Silver Brazed	CJ-9

4 NOTES

4.1 Use K 3/8”-1 3/8” shall be soft annealed and 1 5/8”-12” K shall be hard drawn below ground.

4.2 All copper tubing shall be hard drawn except as stated in “Note 4.1.”

PART 3 - EXECUTION (Continued)

SYSTEM PIPING SCHEDULE 11A
REFRIGERATION
R-410A REFRIGERANT ONLY

1 Install pipe, valves and fittings as designated in this Schedule for this System.

2	LOCATION	ABOVE GROUND		BELOW GROUND	
3	PIPING DESIGNATIONS	LOW SIDE	HIGH SIDE	LOW OR HIGH SIDE	
3.1	CP-29	3/8”-4 1/8”		Note 4.1	
	CP-8	K 5”-12”	3/8” – 1 3/8”		
	CP-8	K	1 5/8” – 2 1/8”	3/8” – 2 1/8”	
	CP-2	Sch. 40 A53	2 1/2” – 4”	2 1/2” – 4”	
3.2	Fittings	Wr. Copper	CF-8	Wr. Copper	CF-8
3.3	Joints	Silver Brazed	CJ-9	Silver Brazed	CJ-9
		Weld	CJ-5		CJ-5

4 NOTES

4.1 3/8 – 1 3/8 shall be soft annealed copper, and 1 5/8” – 2 1/8” shall be hard drawn below ground.

4.2 All tubing shall be hard drawn except as stated in “Note 4.1.”

4.3 CP-2 steel pipe shall be A53 Sch. 40 seamless.

4.4 Buried steel pipe shall be protected. Use Pasco “Pipewrap Primer” then 20 mil Pasco “Pipe Protection Tape System” or an approved equal. Refer to Section 200050 for trenching and backfilling.

PART 3 - EXECUTION (Continued)

SYSTEM PIPING SCHEDULE 13
COIL CONDENSATE AND DRIP WASTE

1 Install pipe, valves and fittings as designated in this Schedule for this System.

2	NOMINAL SIZE RANGE	
2.1	Minimum Diameter	1”
2.2	Maximum Diameter	4”
3	DESIGN	
3.1	Working Pressure Ft. Hd.	10
3.2	Working Temperature °F	Ambient
4	PIPING DESIGNATIONS	
4.1	Hard “L” Copper	CP-8
4.2	Sch. 40 PVC	CP-30
5	FITTING DESIGNATIONS	
5.1	Wrought	CF-8
5.2	Sch. 40 PVC	CF-30
6	JOINT DESIGNATIONS	
6.1	Solder	CJ-8
6.2	Solvent Cement	CJ-33

7 NOTES

7.1 PVC piping installed above ceilings and within all plenum types shall be insulated. Reference Insulation Section 200180.

7.2 All coil condensate piping shall be installed with slope of not less than 1/8” per foot.

PART 3 - EXECUTION (Continued)

SYSTEM PIPING SCHEDULE 14
SANITARY AND VENT-INSIDE BUILDING

1 Install pipe, valves and fittings as designated in this Schedule for this System.

2 ABOVE GRADE

2.1	SANITARY & STORM PIPE DESIGNATIONS		FITTING DESIGNATIONS		JOINT DESIGNATIONS	
2.1.1	1 1/2” and Larger					
2.1.1.1	Cast Iron No Hub	CP-41	No Hub	CF-41	Coupling	CJ-41
2.1.1.2	Sch. 40 DWV PVC	CP-33	PVC	CF-33	Solvent	CJ-33
2.2	VENT PIPE DESIGNATIONS					
2.2.1	1 1/2" and Larger					
2.2.1.1	Cast Iron No Hub	CP-41	No Hub	CF-41	Coupling	CJ-41
2.2.1.2	Sch. 40 DWV PVC	CP-33	PVC	CF-33	Solvent	CJ-33
3	BELOW FLOOR					
3.1	SANITARY, STORM AND VENT					
3.1.1	2” and Larger					
3.1.1.1	Cast Iron Hub	CP-40	Hub	CF-40	Gasket	CJ-40
3.1.1.2	Sch. 40 DWV PVC	CP-33	PVC	CF-33	Solvent	CJ-33

4 NOTES

4.1 PVC piping installed above ceilings and within all plenum types shall be insulated. Reference Insulation Section 200180.

4.2 All waste pipe below kitchen shall be cast iron below footprint of kitchen.

PART 3 - EXECUTION (Continued)

SYSTEM PIPING SCHEDULE 17
DOMESTIC HOT & COLD WATER
ABOVE GROUND

1 Install pipe, valves and fittings as designated in this Schedule for this System.

2	NOMINAL SIZE RANGE		
2.1	Minimum Diameter	1/2"	4”
2.2	Maximum Diameter	3”	8”
3	DESIGN		
3.1	Working Pressure PSIG	125	125
3.2	Working Temperature °F	250	250
4	PIPING DESIGNATIONS		
4.1	Hard “L” Copper	CP-8	CP-8
5	FITTING DESIGNATIONS		
5.1	Cold Press	CF-8A	CF-8A
5.2	Wrought	CF-8	-
5.3	Grooved Mech.	-	CF-6
6	JOINT DESIGNATIONS		
6.1	Cold Press	CJ-8A	CJ-8A
6.2	Solder	CJ-8	-
6.3	Grooved	-	CJ-6
7	VALVES		
7.1	Ball	CV-20	Use only if specifically told to do so – CV-21
7.2	Globe	CV-4, 5	CV-5
7.3	Check Horizontal Swing	CV-7, 8	CV-8
7.4	Butterfly	-	CV-23, 24

8 NOTES

8.1 Install ball valves for balancing services.

8.2 Use flange joint on 3” and larger pipe when connection to equipment or valves.

8.3 Saddle type fittings such as Victaulic style 622 and Gruvlok model 6045 are prohibited.

8.4 See Division 22 “Plumbing” for special valves.

PART 3 - EXECUTION (Continued)

SYSTEM PIPING SCHEDULE 19
FIRE PROTECTION

1 Install pipe, valves and fittings as designated in this Schedule for this System

2	LOCATION LIMITES	BELOW GROUND	ABOVE GROUND	
3	NOMINAL SIZE RANGE			
3.1	Minimum Diameter	4”	1”	2 1/2"
3.2	Maximum Diameter	12”	2”	8”
4	DESIGN			
4.1	Working Pressure PSIG	175	175	175
4.2	Working Temperature °F	WOG	WOG	WOG
5	PIPING DESIGNATIONS			
5.1	Ductile Iron	CP-20	-	-
5.2	Sch. 40 Bl. St.	-	CP-2	-
5.3	Sch. 10 Bl. St.	-	-	CP-2
6	FITTING DESIGNATIONS			
6.1	Ductile Iron Mech. Joint	CF-20	-	-
6.2	Class 125 Cast Iron	-	CF-2	-
6.3	Class 150 Malleable Iron	-	CF-1	-
6.4	Steel Grooved	-	-	CF-6
7	JOINT DESIGNATIONS			
7.1	Mechanical Joint	CJ-20	-	-
7.2	Threaded	-	CJ-1	-
7.3	Mech. Grooved	-	-	CJ-6

8 NOTES

8.1 Valves are specified in Fire Protection Section 211000.

8.2 Provide manufacturer’s standard gasket for service intended on mechanical joint pipe.

8.3 Provide thrust blocks, tie-rods on fittings below grade as required by NFPA #24, Chapter 8.

8.4 The minimum burial depth of exterior fire protection systems shall be 5’-0”.

8.5 Saddle type fittings are prohibited.

PART 3 - EXECUTION (Continued)

SYSTEM PIPING SCHEDULE 20
GAS PIPING

1 Install pipe, valves and fittings as designated in this Schedule for this System.

2	NOMINAL SIZE RANGE		
2.1	Minimum Diameter	1/4"	2 1/2"
2.2	Maximum Diameter	2”	12”
3	DESIGN		
3.1	Working Pressure PSIG	5	5
3.2	Working Temperature °F	150	150
4	PIPING DESIGNATIONS		
4.1	Sch. 40 Bl. St.	CP-2	CP-2
5	FITTING DESIGNATIONS		
5.1	150# Mal. Iron	CF-1	-
5.2	Wrought St.	-	CF-5
6	JOINT DESIGNATIONS		
6.1	Threaded	CJ-1	-
6.2	Welded	-	CJ-5
7	VALVE DESIGNATIONS		
7.1	Cock	CV-10	CV-11
7.2	Eccentric Plug	CV-16	CV-16, 17
7.3	Ball	CV-22	-
7.4	Crane 270 Gas Cock in 1 1/2" and Under		

8 NOTES

8.1 Unions shall be malleable iron railroad unions for 500# WOG.

8.2 Pipe buried below ground to be Dupont Aldyl A or approved AGA equal.

8.3 Steel piping shall connect to plastic piping just below ground. Coat steel pipe which extends into ground with cold asphalt Reilly Tar & Chemical Enamel CA-50; Glass Fiber and Mat Roskote Glasswrap with coat enamel or approved equal.

8.4 Underground piping within building shall be installed in underground conduit, in accordance with National Fire Code 54. Conduit used to encase gas pipe shall be Schedule 40 steel pipe, well wrapped or plastic coated. All joints to be welded. Provide cathode protection for electrolytic action. Conduit shall extend to outside for venting.

8.5 Inspection, testing and purging shall be done as set forth in NFPA #53, Part 4.

3.2 PIPE SUPPORT

A. Pipe Support

1. Furnish and install supports, guides, anchors and swaybraces required for proper installation and support of pipelines except supports noted to be furnished by others.
2. Pipe suspension shall prevent excessive stress and excessive variation in supporting force. Fabrication and installation of supports for pipelines shall not constrain piping to cause excess transfer of load from supports to piping or from support to support when expansion or contraction occurs. Supports shall be capable of taking entire piping load imposed by expansion or contraction.
3. Where pipe vibration transmits objectionable vibration to building structure or attached equipment, hangers shall be supplemented by spring cushions or an energy absorbing means in the supports themselves, or through the addition of flexible piping connectors or other auxiliary equipment.
4. Piping system where flexibility is not desired shall be supported by rigid hangers.
5. See Section 200010, “Attaching to Building Construction” for attaching pipe support to structure.

B. Vertical Pipe Risers

1. Support vertical runs under 15' long with hanger adjacent to elbows.
2. Support vertical runs over 15' with steel riser clamps. Weld clamps to pipe and support on building structure. Space clamps at every floor with maximum spacing of 28'.

C. Hanger Rods

1. Support horizontal pipe with hot rolled steel rod manufactured in accordance with ASTM A107. Space hanger rods to eliminate pipe sagging. Space hangers as listed below. Place hangers within 12" of each horizontal elbow.
2. Steel and Copper Hanger Spacing

PIPE SIZE (NPS)	ROD SIZE (DIAMETER)	MAXIMUM HANGER SPACING
1/2" thru 1-1/4"	3/8"	6'0"
1-1/2" and 3"	1/2"	10'0"
4" and 5"	5/8"	10'0"
6"	3/4"	10'0"
8" thru 12"	7/8"	15'0"
14" thru 18"	Two 7/8"	15'0"
20" thru 24"	Two 1"	15'0"

3. PVC Pipe Support Spacing

PIPE SIZE (NPS)	ROD SIZE (DIAMETER)	MAXIMUM HANGER SPACING
1/2" thru 1"	3/8"	3'0"
1-1/4" thru 3"	3/8"	4'0"
4" thru 5"	1/2"	4'0"
6”	1/2"	4’0”

4. Piping with caulked joints to be supported at each joint.

D. Pipe Hangers (Pipe Suspended from Above)

1. For Hot Lines or Combination Hot and Cold Lines

   a. 2" and smaller iron or steel pipe: adjustable steel clevis hangers. Elcen 12; Grinnell 260; Fee & Mason 239; Crawford 11.
   b. 2" and smaller copper pipe: adjustable copper pipe ring. Elcen 394; Grinnell 97CP; Fee & Mason 365; Crawford.
   c. 2-1/2" thru 12" iron, steel and copper pipe: adjustable steel clevis hangers. Elcen 12; Grinnell 260; Fee & Mason 239; Crawford 11.
   d. 2-1/2" thru 12" iron, steel and copper pipe: adjustable swivel pipe roll (one hanger rod). Elcen 14; Grinnell 174; Fee & Mason 272; Crawford 129.
   e. 14" thru 24" o.d. iron or steel pipe: single pipe roll with adjustable sockets (two hanger rods). Elcen 15; Grinnell 171; Fee & Mason 170; Crawford 15.

2. For Cold Lines

   a. All sizes iron or steel pipe: Elcen 12; Grinnell 260; Fee & Mason 239; Crawford 11.
   b. All sizes copper pipe: adjustable copper-plated ring. Elcen 394; Grinnell 97CP; Fee & Mason 365; Crawford.

3. All hangers used on lines requiring insulation and vapor barrier shall have hangers oversized to allow insulation to pass thru hanger. Install insulation cradles or wood blocks the same thickness as insulation so insulation will not be crushed. Insulation cradles or wood blocks shall be designed for this specific use.

E. Pipe Carriers (Pipe Supported from Below on Racks, Piers, Stands or Trapeze Support)

1. For Hot Lines or Combination Hot and Cold Lines

   a. 3” and smaller Pipe: roller chair with steel U bar support. Elcen 16; Grinnell 176; Fee & Mason 168; Crawford 130.
   b. 4” and larger Pipe: adjustable pipe roll stand with base plate. Elcen 20; Grinnell 274; Fee & Mason 161; Crawford 19.

2. For Cold Lines: all pipe sizes supported on steel pipe chair designed to contain pipe movement in direction perpendicular to pipe run but allow some movement in direction of pipe run.
3. All hangers used on lines requiring insulation and vapor barrier shall have hangers oversized to allow insulation to pass thru hanger. Install insulation cradles or wood blocks the same thickness as insulation so insulation will not be crushed. Insulation cradles or wood blocks shall be designed for this specific use.

F. For sprinkler piping support refer to NFPA#13 (3-10 hangers).

G. Supports for sprinkler piping to be in conformance with NFPA 13, if modified by this section.

H. For piping hanger rod attachment to building, see Section 200010 "Attaching to Building Construction."

3.3 UNDERGROUND PIPING **Reference - Excavation and Backfilling**

A. See Excavation and Backfilling Section 200050.

B. Pre-Insulated Piping Installation Requirements: Piping shall be installed at burial depth noted on the plans, and in accordance with the piping manufacturer's requirements. Provide manufacturer's field technician for installation, unloading, field joint instruction, and testing. Service pipe shall be hydrostatically tested as noted in Section 3, Testing Piping. Joints shall be insulated/jacketed per manufacturer's requirements, using manufacturer's materials.

3.4 ESCUTCHEONS

A. See Escutcheons, Section 200050.

3.5 INSTALLATION OF VALVES

A. Locate valves accessibly and arrange to permit easy removal of fixtures and equipment they serve.

B. Unless otherwise noted, all valves shall be full size of lines in which they are placed.

C. Install all piping and shut-off valves full pipe size as shown on Drawings. Reduce at control valves to control valve size.

D. Valves mounted in horizontal lines shall not have their stems and bonnets pointed below horizontal position unless indicated on Drawings.

E. Provide valves with 3/4" garden hose adaptor for draining low points, boilers, chillers, coils, etc. with cap and chain. Use ball valves for systems which operate below 120°F. Use gate (Crane 431) or globe valves for systems which operate above 121°F.

F. Mount all globe valves to close against flow pressure. Flow should be against bottom of plug.

G. Remove bonnets and trim from all valves before soldering, brazing or welding in piping system. Protect seating surfaces during installation. Clean valve parts thoroughly before reassembling. Install bonnet with valve in open position. Follow manufacturers written instructions to protect valves from overheating during installation.

H. Install all valves with discs or plugs in open position. Close only when assured that sealing parts are free from foreign material. Weld scale or similar foreign materials found embedded in sealing surfaces will require installation of new trim or complete valve.

I. If grooved piping system is used, then only grooved end valves shall be used. **If grooved piping is used, it <u>is</u> <u>not</u> acceptable to use grooved to flanged adapters to install flanged valves**.

J. Install valves as required by control contractor.

3.6 INSTALLATION OF PIPING

A. Offset piping to avoid interference with other work to increase head room under piping.

B. Contractor may, at his option, use pipe bending equipment to form full lengths of pipe to proper configuration indicated on Drawings.

C. Remove raised face from flanges that are to match cast iron flat face patterns.

D. Coat studs, nuts, flange faces and metallic gaskets with material similar to molybdenum disulphide before assembly.

E. Pipe sizes refer to nominal inside pipe diameter except on copper refrigeration lines and steel and wrought iron pipe 14" and larger.

F. Bonney Weldolet Forge Branch Outlet Fittings may be used where steel with welding fittings are specified in lieu of branch outlet tees, provided branch tee is 2 sizes smaller than main. Nipples welded into mains not acceptable.

G. Use galvanized fittings and unions with galvanized pipe.

H. Caulk clearance space in floor sleeves with plastic compound or fire stop material as required.

I. Caulk exterior wall sleeves with thiokol.

J. Install chromeplated pipe escutcheons on bare exposed pipe at wall, floor and ceiling penetrations. Reference 20 00 50 Escutcheons.

K. Use dielectric couplings when joining dissimilar piping materials.

L. Piping shall not pass over electrical apparatus. If conflict is shown on Drawings, notify Engineer prior to installing pipe.

M. Refer to General Requirements for installation of sleeves, escutcheons, cutting and fitting and attaching to building construction.

N. Refer to Insulation Section 200180 for insulation data. PVC piping installed above ceilings and within all plenum types shall be insulated.

O. Conceal all pipes where provisions have been made for this purpose.

P. In case of conflict on Drawings as to pipe size, the larger pipe size shall be installed.

Q. Joints shall be approved type, gas and watertight for system pressure.

R. All pipes shall be cut square, reamed, chamfered and free of all burrs and obstructions. Pipe ends shall have full-bore openings and not be undercut.

S. Piping not serving elevator equipment rooms shall not pass through elevator equipment rooms. If conflict is shown on drawings, notify Engineer prior to installing pipe.

T. Install wells, thread-o-lets and T's as required by control contractor.

U. Copper pipe shall not come in direct contact with mortar or grout. Where copper pipes are exposed to mortar or grout, pipes shall be wrapped with duct tape. This typically happens when pipes pass through masonry walls.

V. All pipes to equipment and isolation valves shall be full pipe size as shown on Drawings regardless of equipment connection size. Use reducers at equipment to reduce to equipment size.

W. Grooved product must be installed per manufacturer's written instructions, which may or may not include extreme lubricant, torque wrench and specified torque ratings. Manufacturer's representative must provide on-site training to field personnel on installation of product.

X. No pulled "T" drilling of copper piping for branch takeoff's allowed.

Y. Condensate piping shall be installed with slope of not less than 1/8" per foot.

3.7 PIPE CLEANING

A. Swab to remove dirt or scale.

B. Flush water system until water runs clear.

C. Operate steam systems until condensate runs clear.

D. Clean all strainers and traps.

3.8 TESTING PIPING

A. Test all piping at 1 1/2 times operating pressure.

B. Test all concealed work before covering with earth, insulation or furring.

C. Notify Engineer not less than 24 hours in advance of all tests.

D. Furnish all fuel and necessary equipment required for tests.

E. Promptly repair all leaks and reapply tests.

F. Install blind flanges or plugs in order to make tests.

G. See Specification Divisions 22 and 23 for additional pressure testing requirements.

3.9 STERILIZATION OF DOMESTIC WATER SYSTEM

A. Flush system thoroughly until water runs clear.

B. Entire system shall be filled with a water/chlorine solution containing 50 parts per million of chlorine. The system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million of chlorine and allowed to stand for three hours.

C. Following the allowed standing time, the system shall be flushed with clean potable water until chlorine does not remain in the water coming from the system.

D. After the above requirements are satisfied, submit samples to local Board of Health for approval.

E. Sterilization shall be redone until approval from the State Board of Health is obtained.

3.10 PIPING JOINT CONSTRUCTION

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

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

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

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

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook", "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

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

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

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Non-pressure Piping: Join according to ASTM D 2855.

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

K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer’s written instructions.

3.11 PIPING CONNECTIONS

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

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
5. “Pulled Tee’s” in copper piping are not allowed.

3.12 GROOVED PIPING

A. Grooved joints shall be installed in accordance with the manufacturer’s latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer and shall be verified as suitable for the intended service. A factory-trained field representative (direct employee) of the mechanical joint manufacture shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed. Contractor shall remove and replace any improperly installed products. A distributor’s representative is not considered qualified to conduct the training.

B. For applicable projects, the grooved coupling manufacturer shall provide inspection services and/or certify the installing contractor for the installation of their product. The manufacturer’s factory trained representative shall provide certification training for the installing contractor’s field personnel in the use of grooving tools, application of groove, and product installation. The training program shall be designed, developed, administered and evaluated in accordance to the ANSI/IACET Standard for Continuing Education and Training. (IACET-International Association for Continuing Education and Training)

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes field applied insulation and jacket materials for all systems. These systems include:

1. System Insulation Schedule 3:
   Coil Condensate Pipe
   Domestic Cold Water Pipe
   Domestic Hot Water Pipe
   Sanitary Waste & Vent

2. System Insulation Schedule 4:
   Refrigeration Suction Pipe
   Refrigeration Hot Gas Pipe
   Refrigeration Liquid Pipe

3. System Insulation Schedule 9:
   Heating and Air Conditioning:
   Supply Air Ductwork

4. System Insulation Schedule 9A:
   Air Handling Unit:
   Outside Air Intake Ductwork

B. Any equipment that is to be factory insulated is specified with respective equipment.

C. All PVC piping installed in a ceiling plenum shall be insulated to provide a flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

D. Any piece of equipment, pipe, or duct, installed in this contract, which is typically insulated to prevent condensation, shall be insulated unless specifically noted otherwise.

E. Internally lined sheet metal is specified in Metal Ducts, Section 233113.

F. Related sections include all applicable Mechanical Sections.

1.3 SUBMITTALS

A. Submit product data for insulation, jacket materials and fittings used in each system as required in Section 200010, “Shop Drawings”.

B. Product data shall include thermal conductivity, thickness, jacket material, insulation material, sealing compounds, flame-spread and smoke-developed ratings for each type of product to be used.

C. Submit test reports of independent testing agency showing conformance with flame-spread and smoke-developed ratings.

1.4 QUALITY ASSURANCE

A. Insulation Contractor shall have completed a minimum of two (2) projects of similar scope. Upon request, the Insulation Contractor shall provide a list of similar projects and references to the Engineer. The engineer may wish to inspect work previously installed by the Insulation Contractor.

B. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

C. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. All insulation to be shipped to site in unopened containers as packaged by Insulation Manufacturers.

B. All containers shall state contents within.

C. Store in clean dry area properly protected from weather and physical damage.

D. Open only containers required to be opened as construction progresses.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers and insulation shields.

B. Coordinate hanger sizes and piping penetrations for pipes requiring insulation, wood blocking and saddles with piping installer.

1.7 SCHEDULING

A. Schedule insulation application after pipe testing and heat trace has been installed.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Refer to Insulation Material Schedules in Execution portion of this Section for Insulation types to be used for each system. When more than one is shown, contractor may choose which type is to be installed.

B. Fiberglass Insulation

1. Glass fiber bonded with a thermosetting resin with thermal conductivity of .27 or less @ 75ºF. Designed for use to 650ºF.

   a. Preformed Pipe Insulation with Jacket: 3 lb/ft^3, ASTM C547, Type 1, Class 1 with factory applied all-purpose, vapor-retarder ASJ jacket, 0.02 perm max water vapor permeance. Designed for use to 850°F max.
   b. Board Insulation: 3 lb/ft^3, ASTM C 612, Type IB, without facing and with FSK jacket manufactured from kraft paper, reinforcing scrim, aluminum foil and vinyl film. Verify jacketing with Engineer prior to insulating exposed ductwork with board insulation within finished spaces. Design for use to 450°F max.
   c. Blanket Insulation: 3/4 lb/ft^3, ASTM C 553, Type II, without facing and with FSK manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film. Designed for use to 250°F max.

2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

   a. Class 1, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
   b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
6. Mineral-Fiber, hydraulic-setting insulating and finishing cement: Comply with ASTM C 449/C 449M.
7. Manufacturers:

   a. CertainTeed Manson
   b. Knauf Insulation.
   c. Owens-Corning Fiberglas Corp.
   d. Schuller International, Inc.
   e. Johns Manville

C. Flexible Elastomeric Insulation

1. Closed cellular or expanded rubber material of high insulating efficiency (K of .25 or better @ 75ºF) and designed for use with temperatures from -40º to 210ºF. Odorless, self-

extinguishing and vapor resistant in compliance with ASTM E-84, 25/50 flame smoke rating. Approved for use in return air plenums.

a. Preformed pipe insulation: ASTM C 534, Type I.
b. Sheet insulation: ASTM C 534, Type II.

2. Adhesive: As recommended by Insulation Material Manufacturer.
3. Ultraviolet – Protective Coating: As recommended by Insulation Manufacturer.
4. Manufacturers:

a. Armacell AP
b. K-Flex
c. Aeroflex

D. Flexible EPDM Rubber Sheet

1. Flexible closed cell, lightweight elastomeric EPDM material with Ultraviolet resistance and insulating qualities for use outdoors.
2. Technical Data

Property	Test Method	Result
Thickness	-	1 ½".
Thermal Conductivity	ASTM C177/C518	0.245 k-value
Service Temperature	ASTM C 411	-297 F to +300 F
Surface Burning Charac-	ASTM D 635	Self-Extinguishing
teristics	ASTM E 84	Flame 25, Smoke 50
Water Absorption	ASTM C 209	0.2% max
Vapor Permeance	ASTM E 96	.03 perms
UV Resistance	ASTM G 7/G90	Excellent
Ozone Resistance	ASTM D 1171	No Cracking
Water Vapor Sorption	ASTM C 1104	0.00 %
Fungi Resistance	ASTM C 1338/ G21 /UL181	No Growth
Dimensional Stability	ASTM C 356	7 % max

3. Manufacturers:

a. Aeroflex USA, Inc. – Aerocell.

E. Duct Liner: See Section 233113.

2.2 ADHESIVES

A. Adhesives or mastics used in the application or manufacture of insulating materials shall be fire retardant with UL flame rating not exceeding 25 and smoke developed rating not exceeding 50 (on dry film) when tested in accordance with ASTM E 84. All adhesives specifically designed for respective application as noted by insulation manufacturer.

2.3 JACKETS

A. PVC Jacket

1. High-impact

a. Fittings – Gloss White, preformed, 30 Mill, PVC jacket designed for use with and provided by same manufacturer of insulation. Fiberglass insert wrapped around fitting and covered by PVC preformed jacket piping insulation system.
b. Sheet – Gloss White, preformed, pre-cut and curled 20 mil PVC jacket designed for use with and provided by same manufacturer of piping insulation system. Ultraviolet-resistant suitable for outdoor service and temperature range 0 – 150ºF. Jacket to be completely sealed with solvent weld for vapor proof barrier where noted in schedule.

B. Foil, Scrim and Kraft-Paper (FSK) Jacket

1. Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil. Maximum of .02 perms moisture vapor transmission, ASTM C 921, Type I, Max 25/50 flame smoke rating.

C. All-Service Jacket (ASJ)

1. White, kraft-paper fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type 1.

D. Aluminum Jacket

1. Aluminum roll stock .020" thick, ready for shop or field cutting and forming. ASTM B209, 3003 alloy, H-14 temper.
2. Aluminum Fittings - Preformed - same thickness and finish as jacket.
3. Jacket Bands - Aluminum 3/4" wide.

E. Stainless Steel Jacket

1. Stainless steel roll stock .020" thick, ready for shop or field cutting and forming. ASTM A66, Type 304 or 316.
2. Stainless steel fittings - Gore Type, same thickness and finish as jacket.
3. Jacket Bands - Stainless steel, Type 304, 3/4" wide.

F. Multilayer Weatherproof Jacket:

1. Pre-fabricated self-adhering, sheet-type protective membrane. The outer (exposed) layer shall be an embossed, UV-resistant aluminum weathering surface. Under the aluminum shall be multiple layers of tough, high-density cross-linked polymer film. Under the polymer film shall be a uniform layer of aggressive rubberized asphalt adhesive which sticks directly to metal, insulation facers and most other clean, dry surfaces. The self-adhesive surface shall be protected by a disposable release liner. Exterior layer shall be brown in color.
2. Technical Data

Property	Test Method	Result
Material Thickness	ASTM D 1970	25 Mils Nom.
Flexibility @ -20°F	ASTM D 1970	Pass
Vapor Permeance	ASTM E 96	.01 perms
Nail Sealability	ASTM D 1970	Pass
Heat Aging	ASTM D 794	Pass
Ultimate Elongation MD	ASTM D 412	434%
Ultimate Elongation CMD	ASTM D 412	246%

2.4 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape

1. Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd. (270 g/sq. m). Tape Width: 4 inches (100 mm).

B. Bands

1. 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

a. Stainless Steel: ASTM A 666, Type 304; 0.020 inch (0.5 mm) thick.
b. Aluminum: 0.007 inch (0.18 mm) thick.

C. Wire

1. 0.080-inch (2.0 mm), nickel-copper alloy; 0.062-inch (1.6 mm), soft-annealed, stainless steel; or 0.062-inch (1.6 mm), soft-annealed, galvanized steel.

D. Welded-Attached Anchor Pins and Washers

1. Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

a. Welded Pin Holding Capacity: 100 lb. (45 kg) for direct pull perpendicular to the attached surface.

E. Adhesive-Attached Anchor Pins and Speed Washers

1. Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

a. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperature of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb. (45 kg) for direct pull perpendicular to the adhered surface.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Insulation for each system as designated in the Insulation Material Schedules on the following pages.

B. When more than one type of insulation system is specified, contractor may choose which type is installed.

C. Reference Products, Part 2 of this Section for specifications and manufacturers of insulation materials designated to be installed in Insulation Material Schedules.

3.0 EXECUTION (Continued)

SYSTEM INSULATION SCHEDULE 3:
COIL CONDENSATE PIPE
DOMESTIC COLD WATER PIPE
DOMESTIC HOT WATER PIPE
SANITARY WASTE & VENT

1 Install insulation materials as designated in this schedule for system(s) listed.

2	LOCATION	INSIDE	OUTSIDE
3	INSULATION		
3.1	Pipe	Fiberglass-Preformed with Jacket	
3.2	Fitting	Fiberglass Blanket	
4	INSULATION THICKNESS		
4.1	Pipe Size	All	
4.2	Thickness	1"	
5	JACKETS		
5.1	Pipe	ASJ Integral to Insulation	
5.2	Fittings	Preformed PVC	
5.3	Vapor-Retardant	Yes	

6 NOTES

6.1 Application of insulation on sanitary waste pipe shall be as follows:

6.1.1 Piping installed above ground floor.

6.1.2 Serving discharge from cooling coils or electric water coolers.

6.1.3 Piping installed in return air plenum.

6.1.4 Where insulation is required, install along pipe lengths connecting fixture to waste stack/main building drain only.

3.1 EXECUTION (Continued)

SYSTEM INSULATION SCHEDULE 4:
REFRIGERATION SUCTION PIPE
REFRIGERATION HOT GAS PIPE
REFRIGERATION LIQUID PIPE

1 Install insulation materials as designated in this schedule for this system.

2	SERVICE	INSIDE	OUTSIDE
3	INSULATION MATERIAL		
3.1	Pipe	Elastomeric	Elastomeric
3.2	Fitting	Preformed	Preformed
4	INSULATION THICKNESS		
4.1	Pipe Size	All	All
4.2	Thickness	3/4"	3/4"
5	JACKETS		
5.1	Pipe	N/A	UV Resistant
5.2	Fittings	N/A	
5.3	Vapor-Retardant	N/A	

3.1 EXECUTION (Continued)

SYSTEM INSULATION SCHEDULE 9:
HEATING AND AIR CONDITIONING:
SUPPLY AIR DUCTWORK

1 Install insulation materials as designated in this schedule for system.

2	LOCATION	INSIDE	INSIDE	INSIDE	EXTERIOR
3	INSULATION MATERIAL	Flexible Fiberglass	Rigid Fiberglass	Flexible Elastomeric	Flexible EPDM Rubber
4	INSULATION THICKNESS	1 1/2"	1 1/2"	3/4"	2”
5	JACKETS	FSK	FSK	FSK	Multi-Layer Weatherproof
5.1	Vapor-Retardant	Yes	Yes	Yes	Yes

6 NOTES

6.1 Use rigid or flexible elastomeric insulation in mechanical rooms. All other areas may be flexible fiberglass.

6.2 Where smaller diameter round ductwork is to be insulated and then painted, utilize pre-formed pipe insulation of required thickness with paper jacketing.

6.3 Insulate ends of reheat coils including VAV box reheat coils in all applications where heating coils are in air conditioning supply ductwork. Install vapor barrier over insulation and seal watertight to adjacent insulation vapor barrier.

6.4 Externally insulate supply air slot diffuser plenums with flexible fiberglass.

6.5 External insulation to have a 1” crown on top to shed water.

6.6 **Where supply and return air branch ducts containing volume dampers are covered using duct wrap, expose volume damper actuator through duct wrap and “spot” paint the duct wrap around the actuator a bright and contrasting color for ease in visually locating the actuator while standing on the floor below the duct.**

3.1 EXECUTION (Continued)

SYSTEM INSULATION SCHEDULE 9A:
AIR HANDLING UNIT AND BOILER:
OUTSIDE AIR INTAKE DUCTWORK
RELIEF/EXHAUST AIR DUCTWORK

1 Install insulation materials as designated in this schedule for system.

2	LOCATION	INSIDE	INSIDE
3	INSULATION MATERIAL	Flexible Fiberglass	Rigid Fiberglass
4	INSULATION THICKNESS	2"	2"
5	JACKETS	FSK	FSK
5.1	Vapor-Retardant	Yes	Yes

6 NOTES

6.1 Insulate all outside air intake ductwork including but not limited to ductwork that serves air handling units and boilers within building envelope. No need to insulate when installed on outside of insulation barrier.

6.2 Use rigid or flexible elastomeric insulation in mechanical rooms. All other areas may be flexible fiberglass. Combustion air ductwork serving condensing boilers and water heaters to be insulated.

6.3 Where ductwork is to be painted, install rigid insulation with glass cloth jacket. Paint with one coat of fire retardant washable white liquid plastic coating. Confirm compatibility with finish paint prior to painting.

6.4 Boiler outside air intake ductwork (combustion air) applies to combustion air intake, both ducted and non-ducted. Combustion air duct to be insulated from where duct enters conditional space to termination point inside building.

6.5 Insulate relief/exhaust air plenums, ductwork, etc., from damper to a point where duct or plenum enters unconditioned space.

3.2 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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

3.3 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.4 GENERAL APPLICATION REQUIREMENTS

A. All insulation that is to be painted shall be all-service jacket (ASJ) unless noted otherwise.

B. Apply insulation only after pipes, ducts and equipment have been tested and cleaned.

C. Protect furniture, equipment, ducts, pipes, etc. with tarpaulins. Keep premises clean.

D. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the entire length.

E. Refer to schedules at the beginning of this Section for insulation materials and thickness, jackets, and fittings required for each system. Unless otherwise indicated, insulation shall be the same type throughout the same service.

F. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

G. Where insulation is applied on ducts, pipes and equipment which are against columns, walls or other equipment without adequate space for insulation, finish off insulation in workmanlike manner to meet approval of Engineer.

H. Apply multiple layers of insulation with longitudinal and end seams staggered.

I. Seal joints, seams and ends of insulation with vapor-retardant mastic on insulation with a compound recommended by the insulation material manufacturer on systems indicated to receive a vapor retardant.

J. Keep insulation materials dry during application and finishing.

K. Insulation shall be applied by craftsmen who are qualified to install insulation.

L. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

M. Apply insulation with the least number of joints practical.

N. Apply insulation over fittings and specialties, with continuous thermal and vapor-retardant integrity, on systems noted to have vapor-retardant jacket.

O. Provide removable sections of insulation or insulation boxes at all points where access is required for servicing of equipment on systems not requiring vapor-retardant jacket.

P. Exposed is defined to mean visible from working zones of finished building. Concealed signifies opposite. Pipes and ducts above ceilings and in crawl tunnels are considered to be concealed. Finished rooms are defined as office, workrooms, instruction, store room areas, equipment rooms, walking tunnels, etc.

Q. Aluminum jackets shall be installed in high traffic areas subject to damage.

R. On systems not requiring vapor-retardant, neatly bevel insulation at all flanges, access cover plates, etc. so that bolts may be removed without disturbing insulation.

S. All hangers used on lines requiring insulation and vapor barrier shall have hangers oversized and insulation cradles to allow insulation to pass thru hanger.

T. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

U. Whenever Insulation Jacket is noted as Vapor Retardant: Overlap insulation facing at seams a minimum of one inch and secure with pressure-sensitive tape or adhesive as recommended by Manufacturer.

V. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

W. Seal penetrations with vapor-retardant mastic.

X. Apply insulation for exterior applications tightly joined to interior insulation ends.

Y. Seal insulation to roof flashing with vapor-retardant mastic.

Z. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions.

AA. Insulation Terminations: For insulation application where vapor retardants are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retardant.

BB. Do not insulate over equipment name plate data.

CC. Seal all punctures in vapor retardant jacket with vapor-barrier adhesive on cooling piping and air conditioning ducts.

DD. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

EE. Do not weld brackets, clips, or other attachment devices to item being insulated unless specifically noted to do so.

3.5 DUCTWORK AND EQUIPMENT INSULATION

A. Blanket Insulation Application

1. Apply insulation with integral jackets as follows:

    a. Pull jacket tight and smooth.
    b. Install anchor pins and speed washers to keep insulation from sagging when duct width exceeds 22”.
    c. Joints and Seams: Cover with tape and vapor retardant as recommended by insulation material manufacturer to maintain vapor seal.
    d. Vapor-Retardant Mastics: Where vapor retardants are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.

2. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire-rated wall and partition penetrations. Maintain vapor-retardant barrier.
3. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor. Provide vapor-retardant mastic on insulation indicated to receive vapor-retardant.

B. Board and Block Insulation Application

1. Blankets, Board, and Block Applications: Secure insulation with adhesive and anchor pins with speed washers.

    a. Apply adhesives according to manufacturer’s recommended coverage rates per square foot, for 100 percent coverage of surfaces to be insulated.
    b. Groove and score insulation materials to fit as closely as possible to the surfaces, including contours. Bevel insulation edges for cylindrical surfaces for tight joint. Stagger end joints.
    c. Protect exposed corners with secured corner angles.
    d. Install adhesive-attached or self-adhesive anchor pins and speed washers on sides and bottoms of surfaces to be insulated as follows:

        1) Do not weld anchor pins to ASME-labeled pressure vessels.
        2) 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
        3) Do not over-compress insulation during installation.
        4) Cut and miter insulation segments to fit curved sided and dome heads of tanks and vessels.

2. Impale insulation over anchor pins and attach speed washers.
3. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. Secure each layer of insulation with stainless-steel bands.
5. Stagger joints between insulation layers at least 3 inches (75 mm).

6. Apply insulation in removable segments on access doors and other elements that require removal for service.
7. Bevel and seal insulation ends around access panels, manholes, hand holes, ASME stamps, and nameplates.
8. Apply vapor-retardant mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retardant.

C. Flexible Elastomeric Thermal Insulation Applications:

1. Apply insulation over entire surface to be insulated according to the manufacturer's written instructions.
2. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
3. Seal longitudinal seams and end joints for Vapor Retardant installation.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.7 PIPING APPLICATION REQUIREMENTS

A. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100mm) o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

    a. Exception: Do not staple longitudinal laps on insulation having a vapor retardant.

4. Vapor-Retardant Mastics: Where vapor retardants are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retardant mastic.

B. Apply insulation to fittings and elbows as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation where scheduled. Secure according to manufacturer's written instructions.

2. Apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Apply jacket material overlapping seams at least 1 inch (25 mm) at each end. Secure with manufacturer's recommended adhesive, attachments and accessories. Seal seams with tape. Use vapor-retardant mastic on insulation indicated to receive vapor-retardant.

C. Apply insulation to valves and specialties as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For strainers, arrange insulation for access to strainer basket without disturbing insulation.
3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape. Also, seal seams with vapor-retardant mastic on insulation indicated to receive vapor-retardant.
4. On piping 3" and smaller, not requiring vapor-retardant, fittings may be insulated with insulating cement equal in thickness to adjoining pipe insulation and troweled to smooth even finish. Do not insulate heating water pipe valves or unions.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

D. Floor Penetrations: Apply insulation continuously through floor assembly. Seal insulation with vapor-retardant mastic where floor supports penetrate vapor-retardant.

E. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retardant mastic.

F. Hangers and Anchors: All hangers used on lines requiring insulation shall have hangers oversized and insulation support shield to allow insulation to pass continuously thru hanger.

1. Install insert materials on all piping 1 1/2" and larger. Apply insulation to tightly joint the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
2. Fabricate inserts of heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:

1 1/2" to 2 1/2" pipe size	10" long
3" to 6" pipe size	12" long
8" to 10" pipe size	16" long
12" and over	22" long

3. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

G. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply jacket material with manufacturer's recommended adhesive, overlapping seams at least 2 inch (50 mm), and seal joints with vapor-retardant mastic.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following fire-suppression piping inside the building:

1. Wet-pipe sprinkler systems.

B. See Division 10 Sections "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.

C. See Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.

1.2 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

1.3 GENERAL

A. Provide all material, labor, engineering and operations for the installation of complete and operable fire suppression system as shown on the Drawings and as specified herein.

B. Provide all equipment and materials including pipes, valves, fittings, sprinkler heads, fire department connections, backflow preventer, pipe supports, specialties and accessories necessary for a complete and approved fire suppression system.

C. This Contractor shall be completely responsible for the design, layout, submittals, installation, testing, certification and acceptance of the fire suppression system by the Indiana Department of Homeland Security Division for Fire and Building Safety.

1.4 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

a. Auditoriums: Ordinary Hazard, Group 1.
b. Building Service Areas: Ordinary Hazard, Group 1.
c. Classrooms: Light Hazard.

d. Corridors: Light Hazard.
e. Display Cases: Light Hazard.
f. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
g. General Storage Areas: Ordinary Hazard, Group 1.
h. Janitors: Ordinary Hazard, Group 1.
i. Laundries: Ordinary Hazard, Group 1.
j. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
k. Office and Public Areas: Light Hazard.
l. Restaurant Service Areas: Ordinary Hazard, Group 1.
m. Restrooms: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500 sq. ft.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over 1500 sq. ft.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500 sq. ft.
d. Remote area may be reduced without revising the density where listed quick response sprinklers are used throughout the system an in accordance with NFPA 13.

4. Maximum Protection Area per Sprinkler:

a. Light Hazard: 225 sq. ft.
b. Ordinary Hazard: 130 sq. ft.
c. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
d. When using extended coverage sprinkler heads, maximum protection area per sprinkler may be increased up to 400 sq. ft. in unobstructed light hazard and ordinary hazard locations and as allowable based on hydraulic calculations.

5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:

a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13 and ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

1.5 SUBMITTALS

A. Product Data: For each product indicated.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable, and as follows:

1. Areas to be sprinkled.
2. Type of hazards and hazard locations.
3. Type and locations of valves, drains, and test pipes.
4. Alarm devices.

5. Riser diagrams.
6. Fire department connections.
7. Location and coordination of electrical connections.
8. Coordination with other trades.
9. Seismic restraints.

C. Field test reports and certificates.

D. Field quality-control test reports.

E. Operation and maintenance data.

F. Submit shop drawings to Insurance Carrier first. Then, submit approved shop drawings to the Indiana Department of Homeland Security for approval. Submit shop drawings bearing stamp of Insurance Carrier and Department of Homeland Security to the Engineer for approval.

G. Shop Drawings must be created in a format compatible with AutoCad .dwg extension.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test. Work shall be performed by a Sprinkler Contractor engaged in the fire suppression industry for a minimum of five (5) years.

B. Equipment Qualifications

1. Each item of equipment shall be capable of performing its function over an extended period of time with a minimum of attention and maintenance. All equipment shall be constructed using new materials designed and built in accordance with the best practices of the industry.
2. The equipment manufacturer shall have been engaged in the fire suppression industry for a minimum of five (5) years.
3. All equipment and components shall bear UL and FM label or marking and shall be FM approved for fire service.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. FM, “Factory Mutual Approval Guide”.
2. UL, “Underwriters Laboratory Fire Protection Equipment Directory.
3. Local Fire Department requirements.
4. Local, city, state, or any other requirements of the Authority Having Jurisdiction.
5. NFPA 13, "Installation of Sprinkler Systems"; 2010 version.
6. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height"; 2010 version.
7. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems"; 2000 version.
8. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances"; 1995 version.

1.7 EXTRA MATERIALS

A. For Projects requiring more than thirty (30) sprinkler heads, provide 10% extra sprinkler heads and head wrench.

B. For Projects requiring three (3) or more flow and/or tamper switches, provide 10% (or a minimum of 1) extra for each device.

C. Provide fifty (50) spare concealed sprinkler head cover plates for the Owner's future use.

1.8 IMPAIRING THE FIRE PROTECTION SYSTEM

A. Coordinate with Owner all existing fire protection systems.

B. Use the FM Global Red Tag Regulations.

C. Plan and coordinate work to minimize the period of time which the system is impaired.

D. In general, reactivate system at the end of each workday, under the supervision of Facilities Management. System may be left impaired overnight only if explicitly authorized by Owner.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Steel Pipe and Fittings

1. Schedule 40: ASTM A53, Type E, Grade B or ASTM A135, Grade A joined by welded joints, mechanical grooved couplings, or threaded joints.
2. Schedule 10: ASTM A135, Grade A joined by welded joints, or mechanical grooved couplings.
3. The manufacturer's name or brand and applicable ASTM standard shall be marked on each length of pipe.
4. Pipe shall have a factory applied protective coating to provide resistance to microbiologically influenced corrosion (MIC).
5. Pipe grooves shall be rolled and shall be compatible with the coupling. Cut grooves are not allowed.
6. Lightwall pipe (i.e. Schedule 30 threaded, Schedule 7 grooved) is not acceptable.
7. The following pipe shall be galvanized:

    a. Pipe exposed to weather.
    b. Drain pipe exposed to atmosphere.
    c. Pipe from fire department connection to check valve.
    d. Pipe indicated on Drawings to be galvanized.

8. Cast iron threaded fittings: ASME B16.4, Class 125, standard pattern.
9. Malleable iron threaded fittings: ASME B16.3, Class 150, standard pattern.
10. Cast iron flanges: ASME 16.1, Class 125.

a. Gaskets shall be full face of 1/8" minimum thickness, red sheet rubber.
b. Flange bolts shall be hexagon head machine bolts with heavy semi-flushed hexagon head nuts, cadmium plated, with dimensions in accordance with ASME B18.2.

11. Grooved joint fittings: ASTM A536 ductile iron casting, minimum 175 psig rated pressure, with dimensions matching steel pipe.
12. Grooved pipe couplings: AWWA C606 and UL 213 rigid pattern, ductile iron housing sections, EPDM rubber gasket, 2-bolt pattern, cadmium plated bolts and nuts. Flexible and 1-bolt pattern couplings are not allowed.
13. Saddle type fittings are prohibited.

B. Hangers and Supports

1. Clevis or Band Hangers: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
3. Trapeze Hangers: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.2 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.

B. Outlet Specialty Fittings:

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

a. Anvil International, Inc.
b. Central Sprinkler Corp.
c. National Fittings, Inc.
d. Star Pipe Products; Star Fittings Div.
e. Victaulic Co. of America.
f. Ward Manufacturing.

2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
a. Saddle Type fittings are prohibited.

C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

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

a. Central Sprinkler Corp.
b. Fire-End and Croker Corp.
c. Viking Corp.

d. Victaulic Co. of America.

D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

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

a. Elkhart Brass Mfg. Co., Inc.
b. Fire-End and Croker Corp.
c. Potter-Roemer; Fire-Protection Div.

E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

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

a. AGF Manufacturing Co.
b. Central Sprinkler Corp.
c. G/J Innovations, Inc.
d. Triple R Specialty of Ajax, Inc.

F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

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

a. CECA, LLC.
b. Merit.

2.3 LISTED FIRE-PROTECTION VALVES

A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

B. Butterfly Valves: UL 1091.

1. NPS 2 and Smaller: Bronze body with threaded ends.

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

1) Global Safety Products, Inc.
2) Milwaukee Valve Company.

2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with grooved ends.

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

1) Central Sprinkler Corp.
2) McWane, Inc.; Kennedy Valve Div.
3) Mueller Company.
4) NIBCO.
5) Victaulic Co. of America.

C. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.

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

a. Central Sprinkler Corp.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Grinnell Fire Protection.
e. Hammond Valve.
f. McWane, Inc.; Kennedy Valve Div.
g. Mueller Company.
h. NIBCO.
i. Potter-Roemer; Fire Protection Div.
j. Reliable Automatic Sprinkler Co., Inc.
k. Star Sprinkler Inc.
l. Stockham.
m. Victaulic Co. of America.
n. Watts Industries, Inc.; Water Products Div.

D. Gate Valves: UL 262, OS&Y type.

1. NPS 2 and Smaller: Bronze body with threaded ends.

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

1) Crane Co.; Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) NIBCO.

2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.

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

1) Crane Co.; Crane Valve Group; Crane Valves.
2) Crane Co.; Crane Valve Group; Jenkins Valves.
3) Hammond Valve.
4) Milwaukee Valve Company.
5) Mueller Company.
6) NIBCO.

E. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.
2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.

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

1) Milwaukee Valve Company.
2) NIBCO.
3) Victaulic Co. of America.

3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

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

1) Central Sprinkler Corp.
2) Grinnell Fire Protection.
3) McWane, Inc.; Kennedy Valve Div.
4) Milwaukee Valve Company.
5) NIBCO.
6) Victaulic Co. of America.

2.4 UNLISTED GENERAL-DUTY VALVES

A. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

B. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

C. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.5 SPECIALTY VALVES

A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.

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

a. AFAC Inc.
b. Central Sprinkler Corp.
c. Grinnell Fire Protection.
d. Reliable Automatic Sprinkler Co., Inc.

e. Star Sprinkler Inc.
f. Victaulic Co. of America.
g. Viking Corp.

B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.

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

a. AFAC Inc.
b. Grinnell Fire Protection.

C. Double-Check Backflow-Prevention Assemblies; DDCV-A :

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

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Watts Industries, Inc.; Water Products Div.
e. Zurn Plumbing Products Group; Wilkins Div.

2. Capacity: Size, location, capacity, and model as indicated on Drawings.
3. Standard: ASSE 1015, UL listed and FMG approved, USC approved, Indiana Department of Environmental Management approved.
4. Operation: Continuous-pressure applications, unless otherwise indicated.
5. Body: Cast iron with FDA approved interior lining complying with AWWA C550 or stainless steel. Stainless-steel springs and corrosion resistant materials throughout.
6. End Connections: Flanged.
7. Configuration: Designed for horizontal, straight through flow. Unit consists of two resilient seated full flow isolation valves, two independently operating spring-loaded poppet-type check valves.
8. Accessories:

a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet. Four resilient seated test cocks for field testing.

2.6 AIR VENT

A. Automatic Air Vent:

1. Description: Automatic air vent that automatically vents trapped air without human intervention.
2. Standard: UL listed or FM Global approved for wet-pipe fire sprinkler systems.
3. Vents oxygen continuously from system.
4. Float valve to prevent water discharge.
5. Minimum Water Working Pressure Rating: 175 psig.

2.7 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

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

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco International.
3. Victaulic Co. of America.
4. Viking Corp.

C. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 199, for nonresidential applications.
2. UL 1626, for residential applications.
3. UL 1767, for early-suppression, fast-response applications.

D. Sprinkler Types and Categories:

1. Nominal 1/2-inch orifice for standard flow sprinkler head.
2. Nominal 17/32-inch orifice extended coverage sprinkler head.
3. "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Pendent sprinklers.
3. Quick-response sprinklers.
4. Recessed sprinklers, including escutcheon.
5. Sidewall sprinklers.
6. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, painted, custom-color painted where indicated on Drawings.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, sidewall, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards: Wire-cage type when head is installed below 7’-6” or in areas subject to physical damage, including fastening device for attaching to sprinkler.

J. Flexible Sprinkler Hose Fittings:

1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with manufacturer furnished bracket for connection to ceiling grid.
3. Pressure Rating: 175-psig minimum.
4. Size: Same as connected piping, for sprinkler.

2.8 FIRE DEPARTMENT CONNECTIONS

A. Freestanding-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; forged aluminum body and powder coat finish, forged aluminum blind cap with powder coat finish, brass identification plate, galvanized steel elbow, 18” high cover sleeve. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads; outlet with NPT pipe threads, and identification base plate with marking similar to "AUTO SPKR & STANDPIPE."

1. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Fire Equipment 6635 with 6645 cap, or a comparable product by one of the following:

    a. Elkhart Brass Mfg. Co., Inc.
    b. Fire-End and Croker Corp.
    c. Potter Roemer
    d. Reliable Automatic Sprinkler Co., Inc.

2. Type: Freestanding, with straight pattern, single Storz inlet and round identification plate.
3. Finish: Rough chrome finish.

2.9 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

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

    a. ADT Security Services, Inc.
    b. Grinnell Fire Protection.
    c. ITT McDonnell & Miller
    d. Potter Electric Signal Company.
    e. System Sensor.
    f. Viking Corp.
    g. Watts Industries, Inc.; Water Products Div.

C. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

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

    a. McWane, Inc.; Kennedy Valve Div.
    b. Potter Electric Signal Company.
    c. System Sensor.

D. Indicator-Post Supervisory Switch: UL 346, electrically supervised, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

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

    a. McWane, Inc.; Kennedy Valve Div.
    b. Potter Electric Signal Company.
    c. System Sensor.

PART 3 - EXECUTION

3.1 GENERAL

A. Inspect preceding work. Verify all dimensions before proceeding with work and coordinate all work and placement of components with other trades.

B. Be responsible for all measurements, fitting and assembly of all work. Prefabrication is done at the Contractor's risk.

C. Installation

1. Drawings indicate general intent and location. Piping shall be installed in the most direct and straight manner as possible. All lines shall be run high enough to permit relocation of lights without moving ceiling grid.
2. Coordinate exact pipe locations with Drawings and other trades before design approval and fabrication of piping. This Contractor shall be responsible for any redesign and fabrication required to fit system into allowable space.
3. Sprinkler piping that passes through a non-sprinkled area shall be adequately protected as required by NFPA 13.
4. Do not route any piping over electrical panels, transformers, or other equipment requiring a clear space above per NEC and NFPA Codes.
5. All piping in finished areas shall be concealed unless shown otherwise on the Drawings.
6. All vertical lines shall be plumb and horizontal lines shall run parallel to building construction.
7. Install horizontal piping to slope to low points so that entire system may be emptied to facilitate testing.
8. Pipe drains to terminate outside the building wherever possible. Location of drains to the building exterior shall be as shown on Drawings or as approved by the Owner.
9. Pipe and fittings shall be inspected for soundness and cleaned of all dirt and other foreign matter prior to be installed. All damaged pipe and fittings will be rejected.

10. Protect open pipe ends whenever work is suspended during construction to prevent foreign material from entering.
11. Chrome plated or other polished finished components shall be installed with care so that marring does not occur to the finish.

D. Zoning

1. Sprinkler system shall be zoned on a floor-by-floor basis. In addition, systems protecting special hazards shall be zoned separately.
2. Refer to Drawings for sprinkler zone locations.

E. Connection To Utilities

1. Contractor shall make all connections to utilities as required to install the system. All connections to utilities and their shutdown shall be arranged with the Owner. Existing system(s) will be shut down and drained by the Contractor.

F. Pipe Supports

1. All piping shall be supported from the structure above with UL approved hangers. Sizing, spacing, and installation shall be in accordance with NFPA 13 except as otherwise shown on the Drawings or specified herein. Comply with other sections of this specification relating to Basic Mechanical Materials and Methods for basic pipe installation.
2. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 250 lb.

G. Main Riser and/or Header Assembly

1. Provide main riser or header assembly consisting of double check backflow preventer, fire department connection, drain valve, pressure gauge and flow switch.

H. Backflow Preventers

1. Install in compliance with state regulations. Mount horizontal, maximum 4 ft. above the floor.
2. Test backflow preventer to ensure proper operation. Inspection shall be performed by a registered inspector in accordance with the Indiana Department of Environmental Management. Submit reports to the Owner and include a copy in the Operation and Maintenance manuals.

I. Fire Department Inlet Connection

1. Provide a check valve with ball drip valve in line connecting fire department connection to fire protection system.

J. Inspectors Test Connection

1. Inspector test connections shall be installed at the most remote point of each sprinkler zone system. Test connections shall be provided with a 1" pipe and valve. Test pipe shall

discharge to the outside through a corrosion resistant orifice of the proper size, where it can easily be seen. Location of discharge shall be as approved by the Owner.

K. Sectional Control Assembly

1. Provide and install sectional control assembly for each sprinkler zone. Sectional control assembly shall include supervised shut off valve, pressure gauge, water flow indicator, test valve, drain valve, sight glass, and orificed union of the proper size.

L. Ball Drip Valves

1. Provide where shown and as required. Locate ball drips in accessible locations and pipe discharge full size to nearest floor drain.

M. Valve Supervisory Switches

1. Provide valve supervisory switches for all water supply shut-off valves.

N. Sprinkler Heads

1. Sprinkler heads shall be installed per manufacturer's recommendations. Heads shall be installed to satisfy all code requirements for head spacing and as herein specified.
2. Finishes shall be protected against scratches, dents and discoloration. Defective items will not be acceptable.

O. Wet Sprinkler System

1. Fire sprinklers shall be provided for the entire building except as follows:

   a. Do not install sprinkler piping or heads in elevator shafts or elevator equipment rooms.
   b. Do not install sprinkler heads in transformer vaults.

2. Air Vent:

   a. Provide at least one air vent in each wet pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping. Where trapped portion of pipe exists, provide air vent for each location.
   b. Provide dielectric union for dissimilar metals, ball or globe valve, and strainer upstream of automatic air vent.

P. Instructions

1. When required approvals of this work have been obtained, and at time designated by the Owner, demonstrate to the Owner's personnel the operation and maintenance of the systems.

3.2 PIPING SCHEDULE

A. Wet Pipe Sprinkler System

1. Pipe 1¼" and larger: Schedule 10 black-steel pipe with roll-grooved ends, grooved-end fittings for steel piping, grooved-end couplings.
2. Pipe 1" and smaller: Schedule 40 black-steel pipe with threaded ends, threaded cast iron or malleable iron fittings, threaded joints.
3. Pipe between Fire Department Connection and check valve: Schedule 40 galvanized-steel pipe with threaded ends, galvanized threaded cast iron or malleable iron fittings, threaded joints; or roll-grooved ends, galvanized grooved-end fittings for steel pipe, grooved-end couplings.

3.3 PIPING INSTALLATION

A. Refer to Division 20 Section "Pipe, Valves, Fittings, and Hangers for Fire Suppression, Plumbing, and HVAC" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

I. Install alarm devices in piping systems.

J. Hangers and Supports: Comply with NFPA 13 for hanger materials.
1. Install sprinkler system piping according to NFPA 13.

K. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Fill wet-pipe sprinkler system piping with water.

3.4 JOINT INSTALLATION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

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

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

D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

E. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

F. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.

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

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and NFPA 14.

a. Shutoff Duty: Use butterfly or gate valves.

2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.

a. Shutoff Duty: Use butterfly or gate valves.
b. Throttling Duty: Use globe valves.

3.6 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install backflow preventers in potable-water supply sources.

3.7 SPRINKLER APPLICATIONS

A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Sprinkler Finishes:

a. Upright Sprinklers: Rough bronze; wax coated where exposed to acids, chemicals, or other corrosive fumes.
b. Recessed Pendent, and Sidewall Sprinklers: Factory painted white, with white escutcheon.
c. Concealed Sprinklers: Rough brass, with factory-painted cover plate. Finish shall be white unless custom-color cover plate is indicated on Drawings.

3.8 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of both dimensions of acoustical ceiling panels and tiles.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.9 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install freestanding-type, fire department connections in level surface.

1. Install protective pipe bollards on three sides of each fire department connection. Refer to Division 05 Section "Metal Fabrications" for pipe bollards.

B. Install ball drip valve at each check valve for fire department connection.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect water-supply piping to fire-suppression piping.

D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

F. Electrical Connections: Power wiring is specified in Division 26.

G. Connect alarm devices to fire alarm.

H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.11 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Coordinate with fire alarm tests. Operate as required.
5. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

C. Sterilization

1. Contractor shall sterilize all piping upstream of fire protection backflow preventer.

a. Flush system thoroughly until water runs clear.
b. Entire system shall be filled with a water/chlorine solution containing 50 parts per million of chlorine. The system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million of chlorine and allowed to stand for three hours.

c. Following the allowed standing time, the system shall be flushed with clean potable water until chlorine does not remain in the water coming from the system.
d. After the above requirements are satisfied, submit samples to Indiana State Board of Health for approval.
e. Sterilization shall be redone until approval from the State Board of Health is obtained. Include copies of the approval in the Operations and Maintenance Manuals.

D. Testing

1. Testing to comply with NFPA 13 Standard.
2. Test backflow preventer to ensure proper operation. Inspection shall be performed by a registered inspector in accordance with the Indiana Department of Environmental Management. Submit reports to the Owner and include a copy in the Operations and Maintenance manuals.
3. Test all piping hydrostatically at not less than 200 psi for 2 hours without loss of pressure.
4. Retest piping that initially fails after corrective actions have been made.
5. All tests shall be made in the presence of the Owner's Representative or as directed by the Engineer. Allow for at least 24-hour notice of all tests.
6. Complete and sign "Contractor's Material and Test Certificates". Make arrangements and pay for all costs for all inspections by the authority having jurisdiction and obtain approval of the installation. Include copies of the certificates in the Operations and Maintenance Manuals.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Backflow preventers.
2. Balancing valves.
3. Thermostatic zone valves.
4. Temperature-actuated water mixing valves.
5. Expansion tanks.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water hammer arresters.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers; BFP-A:

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

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Capacity: Size, location, capacity, and model as indicated on Drawings.
5. Body: Bronze with stainless steel trim.
6. End Connections: Threaded.
7. Configuration: Designed for horizontal, straight through flow.
8. Relief Valve: Designed to admit air directly into the reduced pressure zone via separate channel from the water discharge.
9. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
    c. Strainer: Bronze 'Y'-pattern strainer.

2.2 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bell & Gossett Circuit Setter Plus or a comparable product by one of the following:

    a. Conbraco Industries, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Red-White Valve Corp.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: Equal to pipe-size.
5. Body: Copper alloy with 1/4-inch NPT tapped drain/purge port.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device. Nameplate to be calibrated to assure specific setting.
11. Operation: Valve to have differential pressure read-out ports across seat area and memory stop feature to allow it to be closed for service and then reopened to set point without disturbing balance position.

2.3 THERMOSTATIC ZONE VALVES

A. Thermostatic Zone Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Acorn TZV-2, or approved equal.
2. Construction: Lead-free certified DZR brass body with corrosion resistant and lead-free internal components. It shall include an integral cartridge-style check valve with accessible screens to prevent backflow and to filter debris from entering the valve.
3. Temperature: Factory set to 110°F. Valve is field adjustable from 100°F to 160°F and is made using an Allen wrench and a lockout nut on the bonnet to prevent unauthorized or accidental temperature adjustment.
4. Thermostatic: Commercial quality paraffin actuator.
5. Options (shipped unassembled for field installation):

    a. Three (3) ball shutoff valves.
    b. Inlet temperature gauge.
    c. Pipe union.

6. Operation: Valve shall proportionally modulate to maintain zone temperature based on heat loss and shall stabilize pump demand to prevent cycling.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves; TMV-A:

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

    a. Bradley Corporation
    b. Lawler Manufacturing Company, Inc.
    c. Leonard Valve Company.
    d. Powers; a Watts Industries Co.
    e. Symmons Industries, Inc.

2. Capacity: Size, location, capacity, and model as indicated on Drawings.
3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Type: Exposed mounting, thermostatically controlled water mixing valve.
6. Thermostat: Liquid filled thermal motor and piston control mechanism, or bi-metal spring type.
7. Flow Rate: High-low design (single valve, or two valve manifold). Valves that require a continuously operated circulation pump to maintain low flow accuracy are not acceptable.
8. Material: Bronze body with corrosion-resistant interior components.
9. Connections: Threaded inlets and outlet.
10. Accessories: Check stops on hot- and cold-water supplies, adjustable, temperature-control handle, thermometer on hot water inlet and mixed water outlet.
11. Tempered-Water Setting: Refer Plumbing Equipment Schedule on Drawings.
12. Valve Finish: Rough bronze.

2.5 EXPANSION TANKS

A. Thermal Expansion Tank; ET-A:

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

   a. Amtrol.
   b. Bell & Gossett.
   c. Calefactio
   d. Taco.

2. Capacity: Size, location, capacity, and model as indicated on Drawings.
3. Pressure Rating: 150 psig maximum working pressure.
4. Construction: Diaphragm type expansion tank with polypropylene liner, or full acceptance bladder type.
5. Tank: Welded steel with stainless steel system connection.
6. Factory charge: 40 psig, field adjustable.
7. Finish: Resistant electrostatic paint, beige color.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with FDA-approved interior lining complying with AWWA C550 for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

   a. Strainers NPS 2 and Smaller: 0.020 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
   c. Strainers NPS 5 and Larger: 0.100 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.7 HOSE BIBBS

A. Hose Bibbs; HB-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Woodford Model 24 or a compatible product by one of the following:

   a. Josam Company; Josam Div.
   b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Brass.
4. Seat: Standard 'O' size washer, replaceable. Quarter-turn valves and/or ceramic cartridge valves are not acceptable.
5. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral, non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish: Rough brass.
10. Operation: Optional metal wheel handle.

2.8 WALL HYDRANTS

A. Non-freeze Wall Hydrants; HYD-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Woodford Model B65 or a compatible product by one of the following:

   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Body Material: Brass.
4. Seat: Standard 'O' size washer, replaceable. Quarter-turn valves and/or ceramic cartridge valves are not acceptable.
5. Pressure Rating: 125 psig.
6. Operation: Self draining design with a drainage tube that is pitched to the faceplate to provide positive drainage when water is shut off. Single tube hydrants that require the installation to be sloped to the exterior wall are not acceptable.
7. Operating Rod: Solid brass rod, of length required to match wall thickness.
8. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
9. Outlet Connection: Concealed, with garden-hose thread complying with ASME B1.20.7.
10. Vacuum Breaker: Integral, non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
11. Box: Cast brass, flush mounting with cover.
12. Box and Cover Finish: Chrome plated.
13. Wall Clamp: Required.
14. Operating Keys(s): One with each wall hydrant.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.

3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER HAMMER ARRESTERS

A. Water Hammer Arresters; WHA:

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

   a. AMTROL, Inc.
   b. Josam Company.
   c. PPP Inc.
   d. Sioux Chief Manufacturing Company, Inc.
   e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   f. Tyler Pipe; Wade Div.
   g. Watts Drainage Products Inc.
   h. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Stainless-steel bellows with factory pressurized and sealed cushion chamber.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 20 Section "Pipe, Valves, Fittings, and Hangers for Fire Suppression, Plumbing, and HVAC" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
2. Do not install bypass piping around backflow preventers.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

F. Install water hammer arresters in water piping as follows:

1. In accordance to PDI-WH 201.
2. In upright position.
3. At any fixture having quick-closing valves.
4. In an accessible location. Provide access panels as required. Coordinate with Architectural Drawings.

G. Piping installation requirements are specified in other Division 20 Sections. Drawings indicate general arrangement of piping and specialties.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Test domestic water piping specialties under pressure. Refer to Division 20 Section "Pipe, Valves, Fittings, and Hangers for Fire Suppression, Plumbing, and HVAC" for pressure test requirements.

C. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

A. Set field-adjustable flow of balancing valves. Refer to Circuit Setter Schedule on Drawings for flow rates.

B. Adjust expansion tank pre-charge pressure (40 psig) to match water system pressure.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation:

1. Close-coupled, horizontally mounted, in-line centrifugal pumps.

1.2 SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Circulation Pump; CP-A:

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

a. Grundfos Pumps.
b. Armstrong Pumps Inc.
c. Bell & Gossett Domestic Pump; ITT Industries.
d. Taco.

2. Description: Factory-assembled and -tested, overhung impeller, single-stage, close-coupled, horizontally mounted, in-line centrifugal pumps as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.
3. Pump Construction: All bronze.

a. Casing: Radially split, bronze, with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
c. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
d. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
e. Bearings: Oil-lubricated; bronze-journal or ball type.
f. Capacity: Size, location, capacity, and model as indicated on Drawings.

4. Shaft Coupling: Rigid type if pump is provided with coupling.
5. Motor: Single speed, with grease-lubricated ball bearings.

2.2 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

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

a. Honeywell International, Inc.
b. Square D.
c. White-Rodgers Div.; Emerson Electric Co.

2. Type: Water-immersion sensor, for installation in hot-water circulation piping.
3. Range: 65 to 200 deg F.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V, ac. Coordinate wiring with E.C.
7. Settings: Start pump at 110 deg F and stop pump at 117 deg F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install close-coupled, horizontally mounted, in-line centrifugal pumps with motor and pump shafts horizontal.

E. Install continuous-thread hanger rods and/or fabricate brackets as required. Hanger and support materials are specified in Division 20 Section "Pipe, Valves, Fittings, and Hangers for Fire Suppression, Plumbing, and HVAC."

F. Install immersion-type thermostats in hot-water return piping.

G. Piping installation requirements are specified in other Division 20 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

H. Install piping adjacent to pumps to allow service and maintenance.

I. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 20 Section "Pipe, Valves, Fittings, and Hangers for Fire Suppression, Plumbing, and HVAC."

1. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 20 Section "Pipe, Valves, Fittings, and Hangers for Fire Suppression, Plumbing, and HVAC" for general-duty valves for domestic water piping and for strainers.
2. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 20 Section "Common Materials and Methods for Fire Suppression, Plumbing, and HVAC" for pressure gages and gage connectors.

J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

L. Connect thermostats to pumps that they control.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Miscellaneous sanitary drainage piping specialties.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Cleanouts for Vinyl Tile Floor:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 4141S or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Tyler Pipe; Wade Div.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron
5. Outlet Connection: Spigot.
6. Closure: Bronze plug with straight threads and gasket.
7. Adjustable Housing Material: Cast iron with threads.
8. Frame and Cover Material and Finish: Nickel-bronze with 1/8-inch tile recess.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Light duty.

B. Cleanouts for Terrazzo Floor:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 4181S or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron
5. Outlet Connection: Spigot.
6. Closure: Bronze plug with straight threads and gasket.
7. Adjustable Housing Material: Cast iron with threads.
8. Frame and Cover Material and Finish: Nickel-bronze with 1/2-inch terrazzo recess.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Light duty.

C. Cleanouts for Carpet Floor:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 4021S-Y or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron
5. Outlet Connection: Spigot.
6. Closure: Bronze plug with straight threads and gasket.
7. Adjustable Housing Material: Cast iron with threads.
8. Frame and Cover Material and Finish: Scoriated nickel-bronze with carpet marker.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Light duty.

D. Cleanouts for Concrete Floor:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 4101S or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron
5. Outlet Connection: Spigot.
6. Closure: Bronze plug with straight threads and gasket.
7. Adjustable Housing Material: Cast iron with setscrews.
8. Frame and Cover Material and Finish: Scoriated nickel-bronze.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Extra heavy duty.

E. Exterior Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 4251S or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron cleanout and cast iron double flanged housing.
5. Outlet Connection: Spigot.
6. Closure: Bronze plug with straight threads and gasket.
7. Frame and Cover Material and Finish: Scoriated cast iron with lifting device.
8. Frame and Cover Shape: Round.
9. Top Loading Classification: Heavy duty.

F. Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 4531S-Y or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping.
4. Body: Hub-less, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded bronze plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains; FD-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 2005Y-A or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Combination flashing collar and clamp with seepage openings.
6. Outlet: Bottom, no-hub.
7. Coating on Interior and Exposed Exterior Surfaces: Not required.
8. Sediment Bucket: Not required.
9. Top or Strainer Material: Nickel bronze.
10. Top Description: Adjustable, round, heel-proof, flat.
11. Top Loading Classification: Light Duty.

B. Cast-Iron Floor Drains; SD-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 2005Y-A or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Combination flashing collar and clamp with seepage openings.
6. Outlet: Bottom, no-hub.
7. Coating on Interior and Exposed Exterior Surfaces: Not required.
8. Sediment Bucket: Not required.
9. Top or Strainer Material: Nickel bronze.
10. Top Description: Adjustable, round, heel-proof, flat.
11. Top Loading Classification: Light Duty.

C. Cast-Iron Floor Drains; FD-2:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 2310Y or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.

e. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Combination flashing collar and clamp with seepage openings.
6. Outlet: Bottom, no-hub.
7. Coating on Interior and Exposed Exterior Surfaces: Not required.
8. Sediment Bucket: Not required.
9. Top or Strainer Material: Nickel bronze.
10. Top Description: Adjustable, round, bar grate.
11. Top Loading Classification: Medium duty.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

a. NPS 2: 4-inch minimum water seal.
b. NPS 2-1/2 and Larger: 5-inch minimum water seal.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 20 Section "Pipe, Valves, Fittings, and Hangers for Fire Suppression, Plumbing, and HVAC" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.

4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

H. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

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

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

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Grease interceptors.

1.2 SUBMITTALS

A. Product Data: For each type of interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

B. Shop Drawings: For each type and size of interceptor indicated. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS

A. General

1. Capacity: Size, location, capacity, and model as indicated on Drawings.

B. Grease Interceptor; GI-A:

1. Manufacturers: Subject to compliance with requirements, provide a steel fabricated grease interceptor by one of the following:

a. Zurn
b. Josam.
c. Mifab.

2. Standard: ASME A112.14.3, for intercepting and retaining fats, oils, and greases from food-preparation wastewater.
3. Plumbing and Drainage Institute Seal: Required.
4. Body Material: Acid resistant coated interior and exterior fabricated steel.
5. Internal air bypass
6. Cleanout: Integral.
7. Mounting: Above floor.
8. Flow-Control Fitting: Required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install interceptor inlets and outlets at elevations indicated.

B. Install interceptors according to ASTM C 891. Set level and plumb.

C. Set interceptors level and plumb.

D. Piping installation requirements are specified in other Division 20 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

E. Make piping connections between interceptors and piping systems.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Water Softeners
2. Chemicals.
3. Water testing kits.

1.2 SUBMITTALS

A. Product Data: For each type of water softener and water testing kit indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and connections to piping systems.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance for Steel Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, where indicated.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softener that fail in materials or workmanship within specified warranty period.

1. Water Softener, Warranty Period: Five years from date of Substantial Completion.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Salt for Brine Tanks: Furnish same form as, up to 2500 lb, as required to fill brine tank. Deliver on pallets in 40- or 50-lb packages.
2. Store salt on raised platform where directed by Owner. Do not store in contact with concrete floor.

PART 2 - PRODUCTS

2.1 COMMERCIAL WATER SOFTENERS

A. Pressure-type water softener; WS-A:

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

   a. Aqua Systems*.
   b. Culligan International Company*.
   c. Marlo, Inc*.
   d. Process Solutions*.

   * All systems shall use Fleck control valves.

2. General:

   a. Comply with NSF 61, "Drinking Water System Components--Health Effects."
   b. Capacity: Size, location, capacity, and model as indicated on Drawings.
   c. Configuration: Twin alternating unit with two mineral tanks and one brine tank.

3. Mineral Tanks: Fiberglass reinforced polyester; pressure-vessel quality.

   a. Construction: The mineral tank shall be “polyglass” consisting of an inner shell of virgin polyethylene and an external shell of continuous fiberglass roving.
   b. Pressure Rating: 150 psig minimum.
   c. Wetted Components: Suitable for water temperatures from 40 to at least 120 deg F.
   d. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
   e. Support Legs or Skirt: Constructed of PVC, bonded to tank before testing and labeling.
   f. Upper Distribution System: Single, point type, fabricated from PVC pipe and fittings.
   g. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, non-clogging PE strainers; arranged for even flow distribution through resin bed.

4. Controls: Fully automatic; factory mounted on unit and factory wired.

   a. Adjustable duration of various regeneration steps.
   b. Push-button start and complete manual operation.

c. Sequence of Operation: Program multiport pilot-control valve to automatically pressure-actuate main operating valve through steps of regeneration and return to service.
d. Pointer on pilot-control valve shall indicate cycle of operation.
e. Means of manual operation of pilot-control valve if power fails.
f. Main Operating Valves: Automatic, multiport, diaphragm type with the following features:

1) Slow opening and closing, non-slam operation.
2) Diaphragm guiding on full perimeter from fully open to fully closed.
3) Isolated dissimilar metals within valve.
4) Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
5) Valve for single mineral-tank unit with internal automatic bypass of raw water during regeneration.
6) Sampling cocks for soft water.
7) Special tools are not required for service.

g. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressures, and that does not require field adjustments.

1) Demand-Initiated Control: Equip each mineral tank of twin mineral-tank units with automatic-reset-head water meter in common outlet header that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in gallons and divert flow to other tank. Set to repeat with other tank. Include electrical lockout to prevent simultaneous regeneration of both tanks.

5. Brine Tank: Combination measuring and wet-salt storing system.

a. Tank and Cover Material: Molded PE, 3/8 inch thick.
b. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill.
c. Size: Large enough for at least four regenerations at full salting.

6. Factory-Installed Accessories:

a. Piping, valves, tubing, and drains.
b. Sampling cocks.
c. Main-operating-valve position indicators.
d. Water meters.

2.2 CHEMICALS

A. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.

1. Exchange Capacity: 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb of salt.

B. Salt for Brine Tanks: High-purity sodium chloride; free of dirt and foreign material. Rock and granulated forms are not acceptable.

1. Form: Processed, plain salt pellets.

2.3 WATER TESTING SETS

A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

PART 3 - EXECUTION

3.1 WATER SOFTENER INSTALLATION

A. Install commercial water softener equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.

B. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.

C. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.

D. Install water testing sets mounted on wall, unless otherwise indicated, and near water softeners.

3.2 CONNECTIONS

A. Refer to Division 20 Section “Pipe, Valves, Fittings, and Hangers for Fire Suppression, Plumbing, and HVAC” for piping joining materials, joint construction, and basic installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between water-softener-unit headers and dissimilar-metal water piping with dielectric fittings.

D. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank, and on inlet and outlet headers.

E. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank.

F. Install valved bypass water piping around water softeners.

G. Install drains as indirect wastes to spill into open drains or over floor drains.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning water softeners that do not pass tests and inspections and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

B. Add water to brine tanks and fill with salt.

1. Commercial Water Softeners: Plain salt pellets.

C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:

1. ASTM D 859, "Test Method for Silica in Water."
2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
3. ASTM D 1068, "Test Methods for Iron in Water."
4. ASTM D 1126, "Test Method for Hardness in Water."
5. ASTM D 1129, "Terminology Relating to Water."
6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water softeners.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following fuel-fired water heaters:

1. Light commercial, gas water heaters.
2. Water heater accessories.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 235100 Breechings, Chimneys, and Stacks.

1.3 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

Diagram power, signal, and control wiring.

Design Calculations: Submit detailed drawings certified and approved by manufacturer indicating the required sizing, slope, fittings, dampers, etc. for use with water heater venting configuration.

C. Operation and maintenance data.

D. Warranty.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Light commercial, Gas Water Heaters: One (1) year tank warranty, one (1) year parts warranty.
b. Commercial, Gas Water Heaters: Three (3) year heat exchanger warranty, one (1) year parts warranty.
c. Commercial, Gas Boilers: Five (5) year heat exchanger warranty, one (1) year parts warranty.
d. Storage Tanks: Five-year warranty.

PART 2 - PRODUCTS

2.1 LIGHT COMMERCIAL, GAS WATER HEATERS

A. Atmospheric Tank Type Water Heater; WH-A:

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

a. Lochinvar Corporation.
b. Bradford White.
c. Smith, A.O. Water Products Company.
d. State Industries.

2. General

a. Commercial, Atmospheric, Storage, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
b. Capacity: Size, location, capacity, and model as indicated on Drawings.

3. Storage-Tank Construction: Non-ASME-code steel with 150-psig working-pressure rating.

a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

b. Interior Finish: Glass-lined. Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

4. Factory-Installed, Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
e. Jacket: Steel with enameled finish.
f. Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
g. Temperature Control: Adjustable thermostat.
h. Safety Controls: Automatic, high-temperature-limit.
i. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Draft Hood: Draft diverter; complying with ANSI Z21.12.
6. Automatic Damper: ANSI Z21.66, automatic-vent-damper device with size matching draft hood.
7. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.

2.2 WATER HEATER ACCESSORIES

A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.

B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.

C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.

D. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

E. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
2. Concrete base construction requirements are specified in Division 20 Section "Common Materials and Methods for Fire Suppression, Plumbing, and HVAC."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install gas water heaters according to NFPA 54.

1. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

D. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains.

F. Install thermometer on outlet piping of water heaters. Refer to Division 20 Section “Common Materials and Methods for Fire Suppression, Plumbing, and HVAC."

G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

H. Fill water heaters with water.

3.2 CONNECTIONS

A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to inspect installation, including connections.

B. Perform the following field tests and inspections:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Faucets.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals.
8. Lavatories.
9. Individual showers.
10. Sinks.
11. Ice maker boxes.
12. Clothes washer boxes.

B. Related Sections include the following:

1. Division 22 Section "Healthcare Plumbing Fixtures."

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with the latest adopted version of NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
2. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
3. Stainless-Steel Sinks: ASME A112.19.3.
4. Vitreous-China Fixtures: ASME A112.19.2M.
5. Water-Closet, Flush Valve Trim: ASME A112.19.5.

G. Comply with the following applicable standards and other requirements specified for lavatory/sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
7. NSF Potable-Water Materials: NSF 61.
8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.

H. Comply with the following applicable standards and other requirements specified for bathtub/shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Faucets: ASME A112.18.1.
4. Hand-Held Showers: ASSE 1014.
5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
6. Manual-Control Antiscald Faucets: ASTM F 444.
7. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
8. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Brass Waste Fittings: ASME A112.18.2.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
7. Supply Fittings: ASME A112.18.1.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Grab Bars: ASTM F 446.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

A. Water Closets; WC-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard “Madera FloWise 15” 2234.001 or a comparable product by one of the following:

   a. Kohler Co.
   b. Sloan.
   c. Zurn Plumbing Products Group.

2. Description: Floor-mounting, bottom-outlet, vitreous-china fixture designed for flushometer valve operation.

   a. Style: Flushometer valve.
   b. Bowl Type: Elongated with siphon-jet design.
   c. Height: 15” to rim.
   d. Design Consumption: 1.28 gal./flush.
   e. Color: White.

B. Water Closets; WC-2:

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard “Madera FloWise 16-1/2” 3043.001 or a comparable product by one of the following:

   a. Kohler Co.
   b. Sloan.
   c. Zurn Plumbing Products Group.

2. Description: Floor-mounting, bottom-outlet, vitreous-china fixture designed for flushometer valve operation.

   a. Style: Flushometer valve.
   b. Bowl Type: Elongated with siphon-jet design.
   c. Height: 16-1/2” to rim.
   d. Design Consumption: 1.28 gal./flush.
   e. Color: White.

2.2 WATER CLOSET FLUSHOMETERS

A. Water Closet; WC-1 & WC-2:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan 111-1.28-DFB or a comparable product by one of the following:

a. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Description: Flushometer for water-closet type fixture. Include brass body with corrosion and chlorine resistant internal components, dual-filtered bypass, synthetic rubber diaphragm assembly, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm operation.
b. Style: Exposed.
c. Inlet Size: NPS 1.
d. Trip Mechanism: Oscillating, lever-handle actuator.
e. Consumption: 1.28 gal/flush.
f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.

2.3 TOILET SEATS

A. Toilet Seats; WC-1 & WC-2:

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

a. Bemis Manufacturing Company.
b. Church Seats.
c. Olsonite Corp.

2. Description: Toilet seat for water-closet-type fixture.

a. Material: Molded, solid plastic.
b. Configuration: Open front less cover.
c. Size: Elongated.
d. Hinge Type: Stainless steel, self-sustaining check hinge.
e. Class: Extra heavy-duty, commercial.
f. Color: White.

2.4 URINALS

A. Urinals; UR-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard “Washbrook FloWise” 6590.001 or a comparable product by one of the following:

a. Kohler Co.
b. Sloan.
c. Zurn Plumbing Products Group.

2. Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.

a. Type: Washout.
b. Strainer or Trapway: Stainless steel strainer with integral trap.
c. Design Consumption: 0.5 gal./flush.
d. Color: White.
e. Supply Spud Size: NPS 3/4.
f. Outlet Size: NPS 2.

2.5 URINAL FLUSHOMETERS

A. Urinal; UR-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan 186-0.5-DFB or a comparable product by one of the following:

a. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Description: Flushometer for urinal type fixture. Include brass body with corrosion and chlorine resistant internal components, dual-filtered bypass, synthetic rubber diaphragm assembly, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm operation.
b. Style: Exposed.
c. Inlet Size: NPS 3/4.
d. Trip Mechanism: Oscillating, lever-handle actuator.
e. Consumption: 0.5 gal./flush.
f. Tailpiece Size: NPS 3/4 and standard length to top of bowl.

2.6 FIXTURE SUPPORTS

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

1. Josam Company.
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
5. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Urinal Supports; UR-1:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.

2.7 LAVATORIES

A. Lavatories; L-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard “Ovalyn” 0496.221 or a comparable product by one of the following:

   a. Kohler Co.
   b. Sloan.
   c. Zurn Plumbing Products Group.

2. Description: Under-counter mounting, vitreous-china fixture.

   a. Size: 19-1/4 by 16-1/4 inches rim, 17 by 16-1/4 inches oval bowl.
   b. Color: White.
   c. Finish: Unglazed rim.

3. Subject to compliance with requirements, provide trim products by one of the following:

   a. McGuire Manufacturing Company.
   b. Engineered Brass Company.
   c. Keeney Manufacturing Company.

4. Lavatory Trim

   a. Supplies: Chrome-plated copper with 1/2" NPT x 3/8” OD loose key stops.
   b. Drain: Grid with ADA compliant offset waste.
   c. Drain Piping: NPS 1-1/4 chrome-plated cast-brass P-trap with cleanout; NPS 1-1/4 17-gauge tubular brass waste to wall; and wall escutcheon.

2.8 LAVATORY FAUCETS

A. Lavatory Faucets; L-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Z6915-XL, or an approved equal:
2. Description: Sensor-control mixing valve. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

   a. Body Material: Commercial, solid brass.
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 0.5 gpm.
   d. Centers: Single hole with 4-inch deck plate.
   e. Mounting: Deck, exposed.
   f. Inlet(s): NPS 3/8 tubing, with NPS 1/2 male adaptor.

g. Spout Outlet: Aerator.
h. Power Source: Integral solar panel.
i. Temperature Control: Internal mixer.
j. Warranty: 3-year limited.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Lavatory Shielding; L-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Truebro 2018-AS-L or a comparable product by one of the following:

   a. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
   b. Plumberex Specialty Products Inc.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

   a. Material: Rigid high-impact, stain resistant, PVC.
   b. Nominal Thickness: .093 inches.
   c. UV Protection: Required.
   d. Fasteners: Seven (7) stainless steel screws and wall anchors.
   e. Color: White.

2.10 SHOWER FAUCETS

A. Shower Faucets; SH-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Symmons 96-500-B30-L-V or a comparable product by one of the following:

   a. Leonard Valve Co.
   b. Powers; a Watts Industries Co.

2. Description: Single-handle pressure-balance valve with fixed shower head and handheld shower. Coordinate faucet inlets with supplies.

   a. Body Material: Solid bronze body with bronze and stainless-steel balancing assembly, metal lever handle.
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 2.5 gpm.
   d. Diverter Valve: Not integral with mixing valve, integral volume control.
   e. Construction: Concealed mount, stainless steel balancing piston with renewable seats, adjustable hi-limit stop, integral service stops.
   f. Supply Connections: NPS 1/2, Sweat.
   g. Shower Head Type: Ball joint and head, 4” arm and escutcheon.
   h. Handheld Shower Type: 30” slide-bar mounted with 5-foot metal hose.
   i. Backflow Protection Device for Hand-Held Shower: Inline vacuum breaker.

j. Shower Head Material: Solid brass with chrome-plated finish.
k. Spray Pattern: Adjustable.
l. Handheld Shower Material: Nonmetallic with chrome-plated finish.
m. Warranty: 5 years for commercial installations.

2.11 KITCHEN SINKS

A. Kitchen Sink; SK-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay ELUHAD311855 or a comparable product by one of the following:

a. Just Manufacturing Company.

2. Description: Two-bowl, undercounter-mounting, stainless-steel kitchen type sink.

a. Overall Dimensions: 30-3/4 by 18-1/2by 5-3/8 inches.
b. Metal Thickness: 18-gauge type 304 stainless steel.
c. Left Bowl Dimensions: 13-1/2 by 16 by 5-3/8 inches.
d. Drain: 3-1/2-inch stainless steel crumb cup; Elkay LK35.

1) Location: Center of bowl.

e. Right Bowl Dimensions: 13-1/2 by 16 by 5-3/8 inches.
f. Drain: 3-1/2-inch stainless steel crumb cup; Elkay LK35

1) Location: Center of bowl.

3. Subject to compliance with requirements, provide trim products by one of the following:

a. McGuire Manufacturing Company.
b. Engineered Brass Company.
c. Keeney Manufacturing Company.

4. Sink Trim

a. Supplies: Chrome-plated copper with 1/2" NPT x 3/8” OD loose key stops.
b. Continuous Waste Connection: NPS 1-1/2 chrome-plated cast brass tubing and tailpiece with center outlet.
c. Drain Piping: NPS 1-1/2 chrome-plated cast-brass P-trap with cleanout; NPS 1-1/2 17-gauge tubular brass waste to wall; and wall escutcheon.

2.12 KITCHEN SINK FAUCETS

A. Kitchen Sink Faucets; SK-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn 7872C-XL or a comparable product by one of the following:

a. T & S Brass and Bronze Works, Inc.
b. Chicago Faucet.

2. Description: Kitchen faucet with spray. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 1.5 gpm.
d. Mixing Valve: Single control
e. Centers: 8 inches.
f. Mounting: Deck, exposed.
g. Handle(s): Lever.
h. Inlet(s): NPS 3/8” tubing, with NPS 1/2" male adaptor.
i. Spout Type: 10” swing, solid brass.
j. Spout Outlet: Aerator.
k. Operation: Ceramic, manual.
l. Deck Plate: 8” c-c trim cover plate.
m. Vegetable spray: Required.

2.13 HAND SINKS

A. Hand Sinks; HS-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay SEHS-17Xor a comparable product by one of the following:

a. Just Manufacturing Company.

2. Description: One-bowl, wall mounting, stainless-steel hand sink.

a. Overall Dimensions: 17 by 15 by 14-5/8 inches.
b. Metal Thickness: 20-gauge type 300 stainless steel.
c. Faucet Hole Punching: Three holes, 4-inch centers.
d. Sink Dimensions: 17 by 15 by 11” inches.
e. Bowl Dimensions: 14 by 10 by 5-1/2 inches.
f. 1 ½ inch Drain location: Center of bowl.
g. Include splash mount and goose neck faucet.

3. Subject to compliance with requirements, provide trim products by one of the following:

a. McGuire Manufacturing Company.
b. Engineered Brass Company.
c. Keeney Manufacturing Company.

4. Sink Trim

a. Supplies: Chrome-plated copper with 1/2" NPT x 3/8” OD loose key stops.
b. Drain Piping: NPS 1-1/2 chrome-plated cast-brass P-trap with cleanout; NPS 1-1/2 17-gauge tubular brass waste to wall; and wall escutcheon.

2.14 THREE COMPARTMENT SINKS

A. Three Compartment Sinks; SK-2:

1. Basis-of-Design Product: Elkay.
2. Description: Three-bowl, free-standing, stainless-steel kitchen-type sink.

a. Overall Dimensions: 39 by 19-13/16 by 43-3/4 inches.
b. Metal Thickness: 16-gauge type 300 stainless steel.
c. Bowl 1 Dimensions: 10 by 14 by 10 inches, center drain location.
d. Bowl 2 Dimensions: 10 by 14 by 12 inches, center drain location.
e. Bowl 3 Dimensions: 10 by 14 by 12 inches, center drain location.
f. Accessories:

1) Furnish all standard accessories in addition to those herein.
2) Stainless-steel legs with adjustable bullet feet.
3) Fisher 2” lever waste.

3. Subject to compliance with requirements, provide trim by one of the following:

a. McGuire Manufacturing Company.
b. Engineered Brass Company.
c. Keeney Manufacturing Company.

4. Sink Trim

a. Drain Piping: NPS 2 chrome-plated cast-brass P-trap with cleanout; NPS 2 17-gauge tubular brass waste to wall; wall escutcheon.

2.15 THREE COMPARTMENT SINK FAUCETS

A. Three Compartment Sink Faucets; SK-2:

1. Basis-of-Design Product: Zurn Z842J1-HCT
2. Description: Kitchen faucet without spray. Include hot and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Mixing Valve: Two-handle.
d. Centers: 8 inches.
e. Mounting: Wall, exposed.
f. Handle(s): Lever.
g. Inlet(s): NPS 1/2 female with 2” flanges.
h. Spout Type: 9-1/2” swivel gooseneck with stream regulator, solid brass.
i. Operation: Quarter turn, ceramic, manual.

2.16 MOP SINKS

A. Mop Sinks; MS-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fiat MSB-2424 or a comparable product by one of the following:

a. Swan.
b. Stern-Williams.

2. Description: One-bowl, floor-mounting, molded stone utility sink.

a. Overall Dimensions: 24 by 24 by 10 inches.
b. Drain: 3-inch I.P.S. cast brass with 16-gauge stainless steel dome strainer and lint basket.
c. Accessories:

1) Hose and Bracket: Stainless steel hose bracket, spring-loaded rubber grip, 30” long heavy duty 5/8-inch rubber hose; Fiat 832 AA.
2) Mop Hanger: Stainless steel mop hanger bracket, 24 by 3 inches, 3-spring loaded rubber grips; Fiat 889 CC.
3) Stainless steel wall guards: Heavy gauge stainless steel, two/three panels as required; Fiat MSG 2424.

2.17 MOP SINK FAUCETS

A. Mop Sink Faucets; MS-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Z841M1 or a comparable product by one of the following:

a. T & S Brass and Bronze Works, Inc.
b. Chicago Faucet.

2. Description: Service sink faucet with check stops in shanks, vacuum breaker, hose-thread outlet, and pail hook.

a. Body Material: Commercial, solid brass.
b. Finish: Rough chrome plate.
c. Mixing Valve: Two-handle.
d. Centers: Adjustable.
e. Mounting: Back/wall, exposed.
f. Handle(s): Lever with color coded index button.
g. Inlet(s): NPS 1/2 male shank, with integral check stops.
h. Spout Type: Rigid, solid brass with wall brace.
i. Spout Outlet: Hose thread.
j. Vacuum Breaker: Integral with spout.
k. Operation: Quarter-turn compression, renewable, manual.

2.18 ICE MAKER BOXES

A. Ice Maker Boxes; IMB-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Guy Gray MIB1HAAB or a comparable product by one of the following:

a. Acorn Engineering Company.
b. IPS Corporation.

2. Description: Recessed wall-mounting water supply box.

a. Overall dimension: 4-3/4 by 4-1/8 by 3-1/2 inches.
b. Metal Thickness: 20 gauge cold rolled steel.
c. Supplies: 1/2" sweat inlet.
d. Valve: Integral hammer arrester quarter turn, 1/4" O.D. outlet.
e. Finish: White powder coat.

2.19 CLOTHES WASHER BOXES

A. Washer Boxes; WB-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Guy Gray 82158_A or a comparable product by one of the following:

a. Acorn Engineering Company.
b. Oatey.

2. Description: Recessed wall-mounting water supply box.

a. Overall dimension: 8-1/4 by 5-5/8 by 3-1/2 inches.
b. Metal Thickness: 20 gauge cold rolled steel.
c. Supplies: 1/2" sweat inlet.
d. Valve: Integral hammer arrester quarter turn, 1/2" O.D. outlet.
e. Drain: 2” slipnut drain kit.
f. Finish: White powder coat.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install fixtures level and plumb according to roughing-in drawings.

G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation. All exposed supply piping shall be chrome-plated copper.

H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

L. Install toilet seats on water closets.

M. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

N. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

O. Connect drain outlet hose from dishwasher to drain connection on disposer.

P. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Common Work Materials and Methods for Fire Suppression, Plumbing, and HVAC."

Q. Set **<bathtubs, showers, mop sinks>** in leveling bed of cement grout. Grout is specified in Division 20 Section "Common Work Materials and Methods for Fire Suppression, Plumbing, and HVAC."

R. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following natural gas piping specialties:

1. Gas regulators.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Natural gas piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 GAS REGULATORS

A. Gas Pressure Reducing Valves:

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

a. Pietro Fiorentini.
b. Cashco.
c. Equimeter
d. Fisher.
e. Rockwell.

2. Construction

a. Valve body: Cast iron.
b. Diaphragm case: Die-cast aluminum.
c. Diaphragm: Buna-N with nylon fabric reinforcement.
d. Orifices: Interchangeable brass.

3. Operation: Single stage diaphragm type.
4. Temperature limits: -20°F to 150°F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 20 Section "Pipe, Valves, Fittings, and Hangers for Fire Suppression, Plumbing, and HVAC." for piping joining materials, joint construction, and basic installation requirements.

B. Piping installation requirements are specified in other Division 20 Sections. Drawings indicate general arrangement of piping and specialties.

C. Were gas pressure reducing valves are not located outdoors and away from building openings, relief vent shall be plumbed directly to outside. Multiple vents may be combined.

3.2 FIELD QUALITY CONTROL

A. Remove and replace malfunctioning natural gas piping specialties and retest as specified herein.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes testing, adjusting and balancing of HVAC Systems to produce design objectives, including the following:

1. Adjusting blowers, fans and ducts to deliver or exhaust design air flow.
2. Adjusting terminal units, diffusers, registers and grilles to supply, return or exhaust design air flow.
3. Adjusting relief dampers and vents.
4. Adjusting diffusers, registers and grilles to minimize drafts.
5. Adjusting all zones for design supply and return air flow.
6. Adjusting blowers and fans to design rpm.
7. Balancing of domestic hot water return loop.
8. Sheet metal shop drawing review prior to ductwork installation, review the Sheet Metal Contractor’s duct fabrication drawings and mark any additional balancing dampers, etc. that are required for proper balancing of the systems. This Contractor shall receive two copies from the Sheet Metal Contractor and shall return one copy to Sheet Metal Contractor.

1.3 SUBMITTALS

A. Bidding Documents

1. If so requested on the bid form Submit name of the Test and Balance Agency to Architect/Engineer as a subcontractor on the Materials and Subcontractors Listing.
2. If the Contractor fails to submit name of selected Test and Balance Agency, the Architect/Engineer will select the agency of his choice and Contractor must then issue purchase order for this work as directed.

B. Certificate: Selected and approved agency shall submit certificate immediately upon receipt of test and balance contract.

C. Data Sheets

1. Submit type written data sheets on each item of testing equipment to be used.
2. Include name of device, manufacturer's name, model number, latest date of calibration and correction factors.

D. Report Forms

1. Submit specimen copies of the balance report set-up including addendums and alternates before starting work on site.
2. Submit 30, 60, 90 percent site visit reports on installation of HVAC systems.
3. Forms shall be 8-1/2" x 11" paper for loose-leaf binding, with blanks for listing of the required test ratings and for certification of report.
4. Submit preliminary pencil copies of reports as A/E determines.

E. Final Report

1. Upon completion, all information shall be neatly typed and five copies submitted to the Architect/Engineer with accompanying schematic diagrams of systems tested.
2. All test reports shall be assembled, indexed and submitted in vinyl covered loose-leaf notebooks with project name and Balancing Contractor's name permanently printed thereon.

1.4 QUALITY ASSURANCE

A. Test and Balance Agency

1. Obtain the services of an independent Test and Balance Agency that specializes in, and whose business is limited to, the testing and balancing of air conditioning systems.
2. The agency selected shall be fully certified by the NEBB and shall have at least one member of the agency qualified as a certified test and balance Engineer who has been issued this certification by the National Examining Board.
3. All work shall be done under the direct supervision of a full-time member of the organization.
4. All final reports shall be signed and sealed by the certified test and balance Engineer.
5. Approved Test and Balance Contractors:

    a. Mechanical Systems Balancing
    b. Total Balance
    c. Fluid Dynamics
    d. Gibson Services.
    e. Midwest Balance
    f. Synergy Test and Balance
    g. Bledsoe Test and Balance
    h. Technical Systems Group – Terre Haute

6. Agency Contract: Award the contract to the approved Balance Contractor in sufficient time to allow the Test and Balance Contractor to schedule this work in cooperation with other trades involved and comply with the completion date.

B. Instruments

1. The minimum instrumentation for testing, adjusting and balancing shall be the "NEBB Approved Minimum Field Instrumentation."
2. Instruments used for testing and balancing must have been calibrated within a period of six months and checked for accuracy prior to start of work.
3. Instruments must be maintained and carried in such manner to protect them from excessive vibration and moisture conditions.

4. Approval: all products and instrumentation used shall be subject to approval of the Engineer.

C. Procedure - Methodology: testing and balancing shall be performed in complete accordance with NEBB National Standards for Field Measurements and Instrumentation.

D. Conditions: System Operation - heating, ventilating, and air conditioning equipment including filters, shall be completely installed and in continuous operation as required to accomplish the adjusting and balance work specified. Test and Balance Agency shall give a Check List to the Mechanical and/or Sheet Metal Contractors which, when completed, and returned, will assure the systems are ready to be balanced. A/E shall receive a copy of check list from Mechanical and Sheet Metal Contractors when completed.

1.5 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, Commissioning Agent (if applicable) and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide seven (7) days advance notice for each test. Include scheduled test date and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

D. Measurements – Readjustments

1. Should corrective measures caused by faulty installation require retesting, adjusting and balancing, such work shall be at no additional expense.
2. Corrective measures other than the above shall be made only as directed by the Architect/Engineer. Such work shall be at no additional expense.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PREPARATION

A. Air Systems - prior to system testing and balancing:

1. Verify that the appropriate contractor has:

a. Checked all systems and placed them into a fully operational status.
b. Installed clean filters within the equipment. Do not continue testing of unit until clean filters have been provided.
c. Checked temperature and system controls for proper operation.
d. Checked fan rotation for proper operation.

3.2 SYSTEM BALANCE

A. Air Systems - Perform the following minimum tests and balance:

1. Test and adjust supply, return and exhaust fans to design requirements. Change sheaves and belts as required to obtain design air quantities. Sheaves and belts to be furnished by respective equipment manufacturer. Sheaves shall be sized so that maximum CFM will be obtained with VFD at 100% speed. Slowing VFD is not an acceptable method to obtain maximum CFM.
2. Test and record motor electrical characteristics, RPM, service factor, measured voltage, full load amperes and connected load amperage. Check and record starter heaters, sizes and ratings, replacing belts sizes, etc.
3. Make pitot tube traverse (minimum of 16 points) of main supply ducts and obtain design CFM at fans. Seal all test holes with suitable hole plugs.
4. Test and record system static pressure, suction and discharge.
5. Test and adjust system for design CFM recirculated air.
6. Test and adjust system for design CFM outside air.
7. Test and record entering air temperatures (DB heating and cooling).
8. Test and record entering air temperatures (WB cooling).
9. Test and record leaving air temperatures (DB heating and cooling).
10. Test and record leaving air temperatures (WB cooling).
11. Adjust all main supply and return air ducts to proper design CFM.
12. Adjust all zones to proper design CFM, supply and return.
13. Test and adjust each diffuser, grille and register to within ±10% of design requirements.
14. Each grille, diffuser and register shall be identified as to location and area. Size, type, flow factor and manufacturer of diffusers, grilles, registers and all tested equipment shall be identified and listed.
15. Readings and tests of diffusers, grilles and registers shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustments.
16. The Balance Contractor shall list all controls requiring adjustment by Temperature Control Contractor and assist Control Contractor with required settings.
17. All diffusers, grilles and registers shall be adjusted to minimize drafts in all areas.

B. Record Data

1. Air Systems - record the following minimum data:

a. CFM delivery and RPM of blowers and fans

1) Static pressure at inlet and outlet of blowers and fans
2) All equipment nameplate data
3) Actual running current and voltage of fan motors and settings for solid state overload relays or heater sizes.

b. CFM delivered or exhausted at each diffuser, register, or grille.

C. Equipment Cards

1. Install at each piece of equipment a “check out” card showing all significant operating temperatures, pressures, amperes, voltages, brake horsepower, etc. Check out cards shall

be standard 5" x 8" index cards enclosed in vinafilm card folders securely attached to equipment or wall in immediate area.

D. Owner's Instructions: Balancing Contractor shall arrange with the Owner at a time for the instruction of the Owner's personnel as to the proper operation and maintenance of the equipment.

3.3 ADDITIONAL TEST

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods

1. If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions, if so requested by Owner/Engineer.

END OF SECTION

PAGE LEFT BLANK

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-22, R-134A:

1. High Side: 390 psig.
2. Low Side: 220 psig.

B. Line Test Pressure for Refrigerant R-410A, R407C, R507:

1. High Side: 650 psig.
2. Low Side: 360 psig.

C. Line Test Pressure for Refrigerants R-404A, R-507 and R-407C:

1. High Side: 480 psig.
2. Low Side: 290 psig.

1.3 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe tube and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
2. Certified refrigeration drawings are required to be submitted with shop drawings. The ownness of these drawings is on the manufacturer who provides the refrigeration compressor.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. See Section 200060 for Copper tube and fittings.

2.2 VALVES AND SPECIALTIES

A. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly, 680 psig.
4. Pressure Rating: Factory test at minimum.
5. Maximum Operating Temperature: 250 deg F.

B. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. Working Pressure Rating: 550 psi, capable of handling up to 700 psi.
5. Temperature operation range of -40^{o}F to 300^{o}.
6. Full flow valve with 0 pressure drop.
7. Bi-directional flow.
8. Service port.
9. Compatibility with R410A and PVE (Polyvinyl Ether Oil) oil.

C. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Provided as part of refrigeration equipment package.

2.3 REFRIGERANTS

A. Provided by equipment manufacturer: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. ASHRAE 34, R-22, R-134A, R-410A, R407C, R-507 and R-404A.

PART 3 - EXECUTION

3.1 VALVE AND SPECIALTY APPLICATIONS

A. Install flexible connectors at compressors.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Contractor must have factory provided refrigeration piping schematic showing all lengths, sizes, double suction risers and inverted traps prior to refrigeration installation. Engineer may stop work if piping schematic is not present.

C. Install refrigerant piping according to ASHRAE 15.

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

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

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

G. Install piping adjacent to machines to allow service and maintenance. Drop pipe to floor to allow installation of sound enclosure over chiller.

H. Install piping free of sags and bends.

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

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

M. Slope refrigerant piping as follows:

1. Install traps and double risers to entrain oil in vertical runs.
2. Liquid lines may be installed level.
3. Suction line shall slope down in direction of flow.

N. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

O. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

P. Seal penetrations through fire and smoke barriers according to Section 200050.

Q. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

R. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

S. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

T. When installing piping on unistrut place piping hangers at random distance from each other to minimize harmonics.

3.3 HANGERS AND SUPPORTS

A. Support multi-floor vertical runs at least at each floor.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

a. Fill system with nitrogen to the required test pressure.
b. System shall maintain test pressure at the manifold gage throughout duration of test.
c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.

d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.5 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

3.6 ADJUSTING

A. Start up by certified manufacturer representative.

B. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

PAGE LEFT BLANK

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Duct Liner.
3. Round ducts and fittings.
4. Dual wall insulated duct and fittings
5. Sheet metal materials.
6. Sealants and gaskets.
7. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing and Balancing" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

a. Supply Ducts (Upstream from Air Terminal Units): 4-inch wg.
b. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
c. Supply Ducts (Constant Volume Systems): 2-inch wg.
d. Return Ducts (Negative Pressure): 2-inch wg.
e. Exhaust Ducts (Negative Pressure): 1.5-inch wg.

2. Leakage Class:

a. Round Flat Oval Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
b. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.
c. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
13. The construction documents are not fabrication drawings and are not intended to show all offsets as required for proper ductwork installation. Contractor to field verify all existing conditions and prepare fabrication drawings based on existing conditions. All additional offsets shall be included in bid price.
14. Submit 2 copies of sheet metal fabrication drawings to Testing and Balancing Contractor for his review prior to submitting to engineer.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.

c. Speakers.
d. Sprinklers.
e. Access panels.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Exposed ductwork in finished areas shall have “paint-grip” finish. Ductwork will be field painted.

2.2 DUCT LINER

A. Where noted on Drawings, this Contractor shall insulate inside of duct with liner.

B. All exposed leading edges and transverse joints shall be neatly butted without gaps. All edges shall be factory coated. All field cut edges shall be coated with approved coating/sealant. Manville Superseal Permacote or equal.

C. Nominal insulation thickness to be 1”.

D. Insulation density shall be 1 ½ #/cu. ft.

E. Insulation shall have an air stream surface with an acrylic coating and a biocidal component, which satisfies the requirements of ASTM C1071 – “Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Liner Material).” The material must not support the growth of mold and fungi when tested in accordance with ASTM C665. NBFU approved. All components of duct liner insulation must not exceed 25 flame or 50 smoke developed ratings.

F. Manufacturers:

1. K-Flex USA Duct Liner Gray (Closed Cell)
2. Knauf Duct Liner EM (Fiberglass Type)
3. JohnsManville Linacoustic RC
4. Approved equal.

2.3 ROUND DUCTS AND FITTINGS

A. See Floor Plans for dual wall duct requirements.

B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.
f. United Sheet Metal.
g. LaPine
h. Eastern Sheet Metal
i. JTD Spiral Inc.

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure showing, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure showing, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure showing, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Dual-walled ductwork shall have “paint-grip” finish. Ductwork will be field painted.

2.4 DUAL WALL INSULATED DUCT AND FITTINGS

A. General

1. Construct to pressure classification as noted in Part 1 of this specification section.
2. Construction in general shall be comprised of an airtight, outer pressure shell, a 1" insulation layer and perforated metal inner liner that completely covers the insulation throughout the system.
3. Insulation shall have the following UL maximum rating: Flame Spread 25; Smoke Developed 50.
4. Outer pressure shell and inner liner shall be manufactured from galvanized steel, meeting ASTM A-527-67 in following minimum gauges:

NOMINAL DUCT SIZE	3-6"	7-20"	21-34"	35-48"	49"&UP
Duct-Outer Pressure Shell	26*	24*	22*	20*	16**
Duct-Inner Perforated Liner	24*	24*	24*	24*	20
Fitting-Outer Pressure Shell	20	20	20	18	16
Fitting-Inner Perforated Liner	20	20	20	20	20

* Gauges if made from spiral duct
** Longitudinal seam, continuous butt weld

5. Divided flow fittings are to be made as separate fittings, not tap collars into duct sections, with the following construction requirements:

   a. Sound airtight continuous welds at intersection of fitting body and tap.
   b. Tap liner securely welded to inner liner with weld spacing not to exceed 3”.
   c. Insulation to be packed around branch tap area for complete cavity filling.
   d. Branch connection is to be carefully fit to cut- out openings in inner liner without spaces for air erosion of insulation or sharp projections for noise and air flow disturbances.

6. All seams in pressure shell of fittings are to be continuous welded. Galvanized areas that have been damaged by welding shall be coated with corrosion resistant aluminum paint.
7. Perforations are not to exceed 3/32" diameter.
8. Inner liners of both duct and fittings are to be adequately supported by metal spacers welded in position to maintain spacing and concentricity.

B. Coupling: an inner coupling should be provided to align the inner lining to maintain good air flow conditions equivalent to standard round high pressure duct joints. Butt joints are not suitable for inner liner. This alignment may be accomplished by liner of fitting for slip-joint into pipe or by use of double, concentric coupling with two couplings held by spacers for rigidity and wall spacing. Above 34" I.D., a separate coupling should be provided for inner alignment with pressure shells joined by angle ring flanged connections.

C. Insulation Ends: at end of an insulated section or run, where internally insulated duct connects to uninsulated spiral duct or fitting, fire damper or flex, an insulation end fitting shall be installed to bring the outer pressure shell down to nominal size.

D. All dual wall duct to have mill phosphate finish for painting.

E. Flat Oval Dual Wall Duct and Fitting

1. Within available sizes, flat oval internally insulated duct shall be manufactured from spiral flat oval duct in the following U.S. Standard gauge galvanized steel:

NOMINAL DUCT WIDTH	TO 22”	23-46”	47-72”
Duct-Outer Pressure Shell	24 ga.	22 ga.	20 ga.
Inner Perforated	24 ga.	24 ga.	24 ga.

2. Bracing and reinforcement are to be as recommended by manufacturer for size and pressure conditions in duct. Joints shall be made by using an alignment coupling to connect liners. Pressure shells of ducts below 42" Major Axis dimensions shall be joined by reinforced 18-gauge couplings. Bolted angle flanges with neoprene gaskets shall be used to join pressure shells for ducts above 42" in width.
3. Dual wall flat oval ductwork for sizes not available in spiral construction shall be manufactured in 4' modular sections to the following minimum galvanized metal gauges:

NOMINAL DUCT WIDTH	TO 34”	35-38”	49”&UP
Duct-Outer Pressure Shell	20 ga.	18 ga.	16 ga.
Inner Perforated Liner	20 ga.	20 ga.	18 ga

4. When maximum width of oval duct exceeds 40" or when maximum height exceeds 26" angle iron companion flanges shall be welded to outer shell for stiffness and assembly. Alignment of inner lining shall be by reinforced slip-joint couplings of 18 gauge minimum. Flat oval duct below size limits shall be assembled by double slip-joint couplings formed from 18-gauge sheet metal secured together by welded spacers.
5. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Lindab Inc.
   b. McGill Air Flow LLC.
   c. SEMCO Incorporated
   d. Sheet Metal Connectors, Inc.
   e. United Sheet Metal
   f. LaPine
   g. Eastern Sheet Metal
   h. JTD Spiral Inc.

2.5 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Non-corrosive Environments: Cadmium-plated steel rods and nuts. Clean/degrease for painting where applicable.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure Showing 5-1, "Rectangular Duct Hangers Minimum Size," and Figure showing 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. **Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design**

considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install dual wall insulated duct in exposed areas as noted on Drawings.

C. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

D. Install round ducts in maximum practical lengths.

E. Install ducts with fewest possible joints.

F. Install Type I grease exhaust duct with required minimum slope and cleanouts as required by code. Complete required grease duct light testing and performance testing as required by code or local authority having jurisdiction.

G. Install commercial dishwasher exhaust ductwork with pitch back to dishwasher. Ductwork shall have smooth interiors for proper drainage.

H. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

I. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

J. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

K. Install ducts with a clearance that will allow for insulation thickness.

L. Route ducts so that they do not pass through transformer vaults, electrical equipment rooms, stairwell enclosures and elevator equipment rooms.

M. Where ducts pass through non-fire-rated interior partitions and exterior walls, cover the opening between the partition and duct or duct insulation with sheet metal flanges (picture frames) of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

N. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with “Intermediate Level” standards as identified in SMACNA's "Duct Cleanliness for New Construction Guidelines." All ducts and air openings on equipment shall be covered and protected throughout construction until ready for use.

3.2 SEAM AND JOINT SEALING

A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-1, "Standard Duct Sealing Requirements," unless otherwise indicated.

B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table showing 1-1, "Standard Duct Sealing Requirements."

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter for, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
2. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table showing 5-1, "Rectangular Duct Hangers Minimum Size," and Table showing 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports. Clean/degrease where painting is to occur.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

G. Install stiffener’s, turning vanes, and or air straighteners as required to stop objectionable duct oil canning, or fan surge to the satisfaction of the engineer.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 DUCT SCHEDULE

A. Fabricate supply, return, outdoor air, and relief air ducts with galvanized sheet steel unless noted otherwise on drawings or within specifications.

B. Ductwork exhausting high moisture airstreams, such as shower rooms and locker rooms, shall be fabricated from aluminum or stainless steel. All commercial dishwasher ductwork shall be stainless steel below the ceiling or where exposed. Ductwork above ceilings may be stainless steel or aluminum.

C. Exhaust ductwork from fume hoods and science labs shall be fabricated from stainless-steel or PVC coated sheet steel unless noted otherwise.

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure showing, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure showing, "Vanes and Vane Runners," and Figure showing, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure showing, "Vanes and Vane Runners," and Figure showing, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure showing, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table showing, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry. No spin-in type fittings allowed.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

G. Escutcheons:

1. For all duct penetrations thru walls into finished areas duct shall have neat shop fabricated picture frame escutcheon on finished side of wall.

a. This applies to both round and square duct work.
b. Externally insulated ducts to have escutcheon oversized by thickness of insulation.
c. Ducts without insulation to have escutcheon tight to exterior of duct.
d. Escutcheon to be fastened to wall and not duct.
e. Escutcheon to be of quality finish and paintable.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Materials.
2. Manual volume dampers.
3. Fire dampers.
4. Control dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work on ¼" = 1'-0" scale drawings.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.

2. The construction documents are <u>not</u> fabrication drawings and are not intended to show all offsets as required for proper ductwork installation. Contractor to field verify all existing conditions and prepare fabrication drawings based on existing conditions. All additional offsets shall be included in bid price.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 COUNTER BALANCED BACKDRAFT DAMPERS

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

1. Greenheck EM
2. Ruskin CBD2.
3. United Enertech
4. Pottorff
5. NCA Mfg.

B. Description: Gravity balanced with adjustable weights. Adjustable open from .01” to .15”.

C. Frame: 0.090-inch- thick 6063T5 extruded aluminum, with welded corners and 12-gauge brace at each corner.

D. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with vinyl blade edge seals.

E. Blade Action: Parallel.

F. Blade Axles:

1. Material: Aluminum.
2. Diameter: 0.20 inch.

G. Tie Bars and Brackets: Aluminum.

H. Bearings: Synthetic pivot bushings.

I. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.

J. Sleeve: Minimum 20-gage thickness.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. Flexmaster U.S.A., Inc.
d. McGill AirFlow LLC.
e. METALAIRE, Inc.
f. Nailor Industries Inc.
g. Ruskin Company.
h. Greenheck.
i. Vent Products Company, Inc.
j. United Enertech
k. Pottorff
l. NCA Mfg.

2. Suitable for horizontal or vertical applications.
3. Frames:

a. Hat-shaped, galvanized-steel channels, 16 ga. minimum thickness.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

a. Multiple (min. 16 ga) or Single blade (min. 20 ga)
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized-steel

5. Blade Axles: Galvanized steel.

    a. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

6. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
2. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 1/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include standoff bracket for insulated duct mounting.

D. Remote Operated Balance Dampers

1. Provide cable or electronic operated balance dampers where required to adjust volume dampers above inaccessible ceilings or behind walls.
2. Cable length as required for access via remote adjuster behind an adjustable cover plate for flush finish installation. Refer to A-series drawings for ceiling construction. Cover plate primer coated cover for field painting unless noted otherwise. Like DuroDyne, Young Regulator, or approved equal.
3. Dampers may be electronic balancing damper actuated by hand-held damper positioner that plugs into a connector. Connector plug-in to be inconspicuously mounted and wired to damper. System to have damper position indication. Like Young Regulator EBD with EBDP electronic balance damper positioner tool.

2.4 FIRE DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Airstream
3. Arrow United Industries; a division of Mestek, Inc.
4. Cesco Products; a division of Mestek, Inc.
5. Greenheck Fan Corporation.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. American Warming & Ventilating.
9. Prefco; Perfect Air Control, Inc.
10. Ruskin Company.
11. Vent Products Company, Inc.

12. United Enertech
13. Pottorff
14. NCA Mfg.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 14 gauge and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated fusible links.

2.5 CONTROL DAMPERS

A. Dampers – Insulated Air Foil (Required for Outside Air-Relief Air-Exhaust Air Systems)

1. Damper construction: Incorporate blades equipped with steel shafts and operating in bearings in damper frame, arranged so that all linkages are encased in side channels of frame to decrease friction and eliminate noise.
1. Frames: 16 gauge (minimum) extruded aluminum. Entire frame shall be thermally broken by means of polyurethane resin pockets complete with thermal cuts.
2. Blades: not exceeding 6" in width; air foil shaped, double thickness 22 gauge (minimum) galvanized steel, thermally broken, with 1/2" polystyrene or polyurethane insulation.
3. Bearing: Synthetic.
4. Seals: Installed on all blade edges and frame top and bottom stoops synthetic elastomer: Flexible spring stainless steel compression type for jamb seals.
5. Shafts: All shafts to be a minimum of 1/2" diameter. Actuator shaft shall be welded to the main control damper blade.
6. For multi-section damper assemblies, provide all required linkages and components to operate dampers simultaneously or as specified on Drawings.
7. Insulated dampers shall be utilized for all outside air, relief air, and exhaust air services.

8. Damper Design: Class 1 leakage. 4,000 FPM maximum velocity, provide for tight shutoff, arranged so that leakage does not exceed 8 CFM/FT^2 at a 4" wg pressure differential. Designed for service of 180º F.
9. All dampers for modulating control: proportioning type with adjacent blades rotating in opposite directions. Note: Some proportional type dampers may require parallel rotation. Reference details on Drawings.
10. All dampers for two position action: have blades arranged for parallel rotation.
11. Manufacturers:

    a. Greenheck ICD-45
    b. Ruskin TED50
    c. Tamco 9000 BF
    d. United Enertech TB-155 & TB-156
    e. Pottorff TICD-51BF & TICD-52BF

B. Dampers – Air Foil (Required for Return Air Systems)

1. Damper construction: Incorporate blades equipped with steel shafts and operating in bearings in damper frame, arranged so that all linkages are encased in side channels of frame to decrease friction and eliminate noise.

    a. Frames: 16 gauge (minimum) extruded aluminum.
    b. Blades: not exceeding 6" in width; air foil shaped, double thickness galvanized steel for 14-gauge equivalent thickness.
    c. Bearing: Synthetic.
    d. Seals: Installed on all blade edges and frame top and bottom stoops synthetic elastomer: Flexible spring stainless steel compression type for jamb seals.
    e. Shafts: All shafts to be a minimum of 1/2" diameter. Actuator shaft shall be welded to the main control damper blade.

2. Damper Design: Class 1 leakage. 4,000 FPM maximum velocity, provide for tight shutoff, arranged so that leakage does not exceed 8 CFM/FT^2 at a 4" wg pressure differential. Designed for service of 180º F.
3. All dampers for modulating control: proportioning type with adjacent blades rotating in opposite directions. Note: Some proportional type dampers may require parallel rotation. Reference details on Drawings.
4. For multi-section damper assemblies, provide all required linkages and components to operate dampers simultaneously or as specified on Drawings.
5. All dampers for two position action: have blades arranged for parallel rotation.
6. Manufacturers:

    a. Greenheck VCD
    b. Ruskin CD50
    c. Tamco 1500
    d. United Enertech
    e. Pottorff

2.6 FLANGE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.8 DUCT-MOUNTED ACCESS DOORS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Buensod Stacey Type F.

9. Ventfabrics, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
11. Pottorff

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
d. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.9 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 20 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.

2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 20 to plus 250 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.10 FLEXIBLE DUCTS

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

1. Wiremold Type 86-C.
2. Aircon-Duct.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow LLC.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 4-inch wg positive and 1-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.

C. Flexible Duct Connectors:

1. Clamps and Sheetmetal Screws: Nylon strap in sizes 3 through 18 inches with 3 sheetmetal screws to prevent blow-off of duct, to suit duct size.
2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts and aluminum accessories in aluminum ducts.

C. Install backdraft and/or control isolation dampers at outlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Install volume dampers at all locations as required for balancing whether shown or not. Dampers specified on backs of grilles shall not be used for balancing unless approved by Engineer.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire, smoke, combination fire and smoke and ceiling radiation dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
3. At changes of direction of kitchen hood exhaust ducts.
4. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.

3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 200050.

L. Install flexible canvas connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct rated at 10" static, strapped in place with 3 sheet metal screw stop keep straps from blowing off ducts. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to low-pressure ducts with maximum 36-inch lengths of flexible duct (rated at 4" static) strapped in place.

P. Connect flexible ducts to metal ducts with draw bands plus sheet metal screws.

Q. Install duct test holes where required for testing and balancing purposes.

R. All dampers that penetrate building envelope shall be insulated dampers. This includes all exhaust, return and relief dampers.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

PAGE LEFT BLANK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes ceiling-, floor- and wall-mounted diffusers, registers, and grilles.

This Section includes but is not limited to:

1. Ceiling Diffusers
2. Grilles and Registers

B. Related Sections include the following:

1. Division 08 Section “Louvers and Vents” for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts. Coordinate with Architect as to whom is supplying grilles.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Round Ceiling Diffuser:

1. Manufacturers:

a. Price Industries

b. Titus TMRA
c. Nailor Industries
d. MetalAire

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Style: Four cone
5. Mounting: Duct connection.
6. Pattern: Fully adjustable.
7. Accessories:

a. Plaster ring (when applicable).
b. All back surfaces factory insulated with foil-backed insulation or molded insulation blanket.

B. Square Ceiling Diffusers:

1. Manufacturers:

a. Price Industries
b. Titus
c. Nailor Industries
d. MetalAire

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Size: As scheduled on the Drawings.
5. Face Style: Three cone.
6. Mounting: Surface, T-bar, Snap in or Panel mounted. Reference Architectural drawings for ceiling type.
7. Pattern: Adjustable.
8. Accessories:

a. Plaster ring (when applicable).
b. All back surfaces factory insulated with foil-backed insulation or molded insulation blanket.

9. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

2.2 GRILLES AND REGISTERS

A. Manufacturers:

1. Price Industries
2. Titus
3. Nailor Industries

4. MetalAire

B. Capacity, size, and noise criteria as Scheduled (Return and Exhaust). Additional sizes may be required as indicated and noted on individual Drawings.
C. Material: Heavy gauge steel or heavy gauge aluminum. Provide aluminum construction for installations in shower rooms and corrosive environments.
D. Finish: Baked enamel, white (unless noted otherwise on Drawings).
E. Mounting: Countersunk screws
F. Frame: 1-1/4” wide.
G. Metal plaster frames: for grilles mounted on plaster, masonry, fiber or metal construction surfaces.
H. Panel mounted where installed in T-bar ceilings unless noted otherwise.
I. Volume Damper: Opposed blade operable through face of grille.
J. Deflecting Blades: 3/4" spacing
K. Supply Grilles: Similar to Titus 272 Series - airfoil blades, double deflection. Horizontal blades always mounted nearest grille face.
L. Return Grilles: Similar to Titus 350 Series - single deflection blades fixed at 35°/45° down (unless noted otherwise on Drawings).
M. Exhaust Grilles: Similar to Titus 350 Series - single deflection blades fixed at 35°/45° down.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel if not of panel dimension. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Complete residential-style, packaged furnace, matched with evaporator coil, air-cooled condensing unit and line set from single manufacturer.
2. See schedules on drawings for furnace type: gas-fired or electric resistance heat with air-cooled condensing unit or heat pump.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each of the following:

1. Furnace.
2. Thermostat.
3. Air Filter.
4. Condensing Unit.
5. Line Sets.

B. Include diagrams for power, signal and control wiring.

C. Operation and Maintenance Data.

D. Warranty.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:

1. Warranty Period, Commencing on Date of Substantial Completion:

a. Furnace Heat Exchanger: 10 years.
b. Integrated Ignition and Blower Control Circuit Board: Five years.

c. Draft-Inducer Motor: Five years.
d. Electrical Coil: Five years.
e. Refrigeration Compressors: Five years.
f. Evaporator and Condenser Coils: Five years.

PART 2 - PRODUCTS

2.1 FURNACES

A. Cabinet: Steel

1. Cabinet interior around heat source shall be factory-installed insulation.
2. Lift-out panels shall expose burners, electric heat elements and all other items requiring access for maintenance.
3. Factory paint external cabinets in manufacturer's standard color.
4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.

1. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.

C. Natural Gas-Fired:

1. Heat Exchanger: Condensing, min. 92% AFUE, aluminized steel primary heat exchanger, stainless steel secondary heat exchanger.
2. Gas Valve: 100 percent safety two-stage main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
3. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.
4. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
5. Flame Rollout Switch: Installed on burner box; prevents burner operation.
6. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
7. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings pre-purges heat exchanger and vents combustion products; pressure switch prevents furnace operation if combustion-air inlet or flue outlet is blocked.

a. Vent Materials: CPVC or PVC

D. Electric-Resistance Heating:

1. Heating Element: Helix-wound, nickel-chromium wire-heating elements in ceramic insulators mounted on steel supports.
2. Sequencer relay with relay for each element; switches elements on and off, with delay between each increment; initiates, stops, or changes fan speed.

E. Furnace Controls: Circuit board integrates, heating, cooling and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories. See schedule for required stages of heating and cooling.

F. Accessories:

1. See Schedule for options and accessories.

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

1. Carrier
2. Trane
3. Lennox
4. Bryant

2.2 THERMOSTATS

A. Wall-mounted, programmable, microprocessor-based unit with automatic switching from heating to cooling, preferential rate control, seven-day programmability with minimum of four temperature presets per day, vacation mode, and battery backup protection against power failure for program settings.

B. Control Wiring: Unshielded twisted-pair cabling.

1. No. 24 AWG, 100 ohm.
2. Conductors as required for service.

2.3 AIR FILTERS

A. Disposable Filters: 4-inch-thick MERV 8 (min.) fiberglass media, pleated air filter, slide in filter frame with removable door.

B. Provide spare filters for each furnace as noted in 200010 “Common Work Results for Fire Suppression, Plumbing & HVAC”.

2.4 AIR-COOLED CONDENSING UNITS AND HEAT PUMPS, 1 TO 5 TONS

A. Description: Factory assembled and tested, consisting of compressor, condenser coil, fan, motors, refrigerant reservoir and operating controls.

B. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.

1. Motor: Two stage, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
2. Accumulator: Suction tube.
3. Refrigerant Charge: R-410A
4. Reversing Valve

C. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.

D. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection.

E. Efficiency: Energy Star Rated, minimum 15 SEER

F. Accessories:

1. Crankcase heater.
2. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.
3. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.
4. Filter-dryer (replaceable core type), slight glass.
5. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
6. Liquid-line solenoid.
7. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
8. Precharged and insulated suction and liquid tubing. See 232300 Refrigerant Piping
9. Thermostatic expansion valve.
10. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.

G. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

H. Unit in cooling shall be capable of operating down to 40 deg F ambient. In heat pump mode unit shall operate down to at least 20 deg F.

I. Verification of Performance: Rate condensing units according to ARI 210/240

J. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

K. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

L. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.

B. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.

1. Install seismic restraints to limit movement of furnace by resisting code-required seismic acceleration.

C. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.

D. Controls: Install thermostats at 48 inches above floor to top of thermostat backbox.

E. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.

F. Install ground-mounted, compressor-condenser components on existing concrete or on polyethylene mounting base.

3.2 CONNECTIONS

A. Gas piping installation requirements are specified in Division 20. Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Vent and Outside Air Connection, Condensing, Gas-Fired Furnaces: Connect CPVC piping vent material to furnace connections and extend outdoors. Terminate vent outdoors with a cap and in an arrangement that will protect against entry of birds, insects and dirt.

1. Slope pipe vent back to furnace or to outside terminal.

D. Connect refrigerant tubing kits to refrigerant coil in furnace and to air-cooled, compressor-condenser unit.

1. Flared Joints: Use ASME B16.26 fitting and flared ends, following procedures in CDA's "Copper Tube Handbook."
2. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
3. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

E. Manufacturer to review drawings and provide any additional equipment, i.e. larger line set size, DX value, etc, as required.

F. Comply with requirements in Division 23 Section "Refrigerant Piping" for installation and joint construction of refrigerant piping.

G. Complete installation and startup checks and start units according to manufacturer's written instructions.

H. Verify proper operation of capacity control device.

I. Adjust airflow and initial temperature set points.

J. Set controls, burner, and other adjustments for optimum heating performance and efficiency.

K. After completing installation, clean furnaces internally according to manufacturer's written instructions.

L. Install new filters in each furnace within 14 days after Substantial Completion.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.
2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Package Air-to-Air Energy Recovery Ventilator (ERV) with:

a. Air Rotation Wheel
b. Exhaust and Supply Fans
c. Complete integral controls
d. Motorized dampers

1.2 TRANSPORT

A. All units to be shrink wrapped for shipping and have a method of humidify control installed at the factory (desiccant bags, electric heater, etc.) and removed after installation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Unit dimensions and weight.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.
3. Fans:

a. Certified fan-performance curves with system operating conditions indicated.
b. Certified fan-sound power ratings.
c. Fan construction and accessories.
d. Motor ratings, electrical characteristics, and motor accessories.

4. Filters with performance characteristics

B. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For air-to-air energy recovery equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of air-to-air energy recovery equipment.

2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ARI Compliance: Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Rating Air-to-Air Energy Recovery Equipment."

C. ASHRAE Compliance: Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. UL Compliance: Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."

1.5 WARRANTY

A. See Equipment Warranty and Early Equipment Startup, Common Work Results for Fire Suppression, Plumbing and HVAC, Section 200010.

PART 2 - PRODUCTS

2.1 PACKAGE AIR TO AIR ENERGY RECOVERY UNIT

A. Manufacturers

1. Greenheck
2. SEMCO Incorporated.
3. Systemair Topvex

B. Casing

1. Standard panels shall be 20-gauge galvanized steel, lined with 1/2-inch-thick neoprene insulation where required. The housing shall be supported by a formed structural base that forms a pan to ensure weather tight construction. Lifting holes shall be provided at the unit base. Units shall have a weatherproof sheet metal roof. The outdoor air intake opening shall be protected by a galvanized steel sheet metal weather hood and include an automatic shutoff damper with electric operator. The exhaust air discharge shall be covered with a gravity back draft damper and weather hood. The exterior of the unit shall be coated with an epoxy primer and a polyurethane enamel painting system for added protection. Painting system shall be rated to meet a 1500-hour salt spray test.

C. Access

1. Access to components shall be provided through a large, tightly sealed and easily removable access panel. Access panels shall be constructed of the same materials as the unit casing and use standard hardware. The wheel cassette shall be easily removable from the unit. The roof of the unit shall also be removable for access.

D. Unit Configuration

1. The supply air inlet and exhaust air outlet must be oriented at opposite ends of the Energy Recovery System to maximize the distance between the two airstreams in order to minimize the risk of short-circuiting exhaust air into the supply air intake.

E. Fans

1. Fans shall be double width double inlet design with forward curve type wheels and VFD motors. The blades shall be designed for maximum efficiency and quiet operation. Impellers shall be statically and dynamically balanced.

F. Energy Wheel

1. The rotor media shall be made of aluminum, which is coated to prohibit corrosion. All surfaces shall be coated with a non-migrating adsorbent specifically developed for the selective transfer of water vapor. The desiccant shall utilize a 3A molecular sieve certified by the manufacturer to have an internal pore diameter distribution which limits adsorption to materials not larger than the critical diameter of a water molecule (2.8 angstroms). In addition, the face of the media shall be coated with an acid resistant coating to provide maximum protection against face oxidation. Equal sensible and latent recovery efficiencies shall be clearly documented through a certification program conducted in accordance with ASHRAE 84 and ARI 1060 standards. The media shall be cleanable with lower temperature steam, hot water or light detergent, without degrading the latent recovery. Dry particles up to 600 microns shall freely pass through the media. Wheel media shall be independently tested and shown to conform to the requirements of NFPA-90A, documenting a flame spread of less than 25 and a smoke generation rating of less than 50.
2. Manufacturers using wheels with a rotor based on non-aluminum materials (i.e., paper, plastic or Mylar) that require periodic replacement, shall provide the owner with a spare wheel or equivalent wheel segments for future use and storage.
3. Cross-Contamination: The cross-contamination characteristics of the selected desiccant shall also be certified by an independent third party of good repute. If said certification is not available, the outside air requirement for each specified unit shall be multiplied by a factor given in the table below for each desiccant. It shall be the contractor's responsibility to resize the duct work/air conditioning equipment and take responsibility for proper system operation at the higher OA CFM if a desiccant other than 3A is used. This factor has been determined by the research performed at the Georgia Institute of Technology.

		With Purge	
Desiccant	3A*	4A*	Silica Gel
Ventilation Factor	1.00	1.16	1.40

	Without Purge		
Desiccant	3A*	4A*	Silica Gel
Ventilation Factor	1.03	1.20	1.46

3A* = 3 Angstrom Molecular Sieve
4A* = 4 Angstrom Molecular Sieve

Note: Any desiccant not listed above requires manufacturer to contact the engineer for the correct Ventilation Factor.

G. Rotor Cassette

1. The rotor cassette shall be a sheet metal framework, which limits the deflection of the rotor due to air pressure. The cassette shall be made of galvanized steel to prevent corrosion. The rotor cassette shall be easily removable from the Energy Recovery Unit to facilitate rigging (if necessary) and ease of service. The wheel cassette design shall use pillow block bearings for long life. A non-adjustable purge sector shall be included in the cassette. Belt shall be replaceable without wheel removal.

H. Filters

1. The filters shall be 1 inch thick mounted in the outside air intake and in the return air plenum. Provide 3 complete sets of filters.
2. Install gauges across filters to monitor filter differential pressure.

I. Airflow Monitor

1. Unit shall include two integral airflow meters that read both ventilation and exhaust airflow expressed in CFM. Monitor gauges to be mounted on unit exterior. Monitors will use differential pressure across wheel to determine airflow.

J. Rotation Detector

1. Unit shall be equipped with a rotation sensor and controller such that should the energy recovery wheel not rotate during a signaled run period, the controller shall send a 24-volt AC signal suitable for operating a relay to be used as an alarm contact. The controller shall not initiate an alarm during a stop/jog function. In addition, this controller shall be equipped with an outdoor air temperature sensor such that the energy recovery wheel can be stopped during moderate temperature periods. The controller shall perform a stop/jog function for the wheel long enough to promote the self-cleaning features of the wheel but not long enough to induce energy recovery. This same temperature controller shall allow the energy recovery wheel to be operated in stop/jog mode during very low temperature periods to prevent freezing of the wheel while still delivering outdoor air through the unit.

K. Freeze Protection Thermostat

1. Unit shall be equipped with an outdoor air temperature thermostat such that the energy recovery ventilator can be stopped during very low temperature periods. This thermostat shall stop both the fans and the energy recovery wheel until the outdoor air temperature rises above the set point, then the unit will restart immediately.

L. Electrical Preheat Coil

1. Coil shall be of the resistance coil type with elements enclosed in a steel sheath with fins and painted with a baked-on aluminum paint for long life in a 100% fresh air stream. Coil shall include thermal cutout protection with automatic primary protection and a secondary manual reset linear thermal cutout. Coil shall have magnetic safety and backup contactors, main disconnect, fusing, control circuit transformer, airflow interlock switch and SCR controller. Coil shall be UL listed and constructed in accordance with NEC requirements. A temperature controller located in the outdoor air section of the unit shall supply the signal to the SCR controller.

M. Electrical

1. Units shall have a single point power connection for all fan motors and internal controls. See schedule for voltage and phase requirements. The electrical panel shall consist of individual motor variable frequency drives, short circuit and overload protection and control power transformer. The NEMA 3R electrical panel shall be mounted on the unit exterior for ease of access. Unit shall be ETL listed and labeled.

N. Wheel Warranty

1. Manufacturer shall warrant to the buyer for a period of 60 months that the wheel contained in the energy recovery unit in all material respects to be free from defects in material and workmanship when used in a proper and normal manner. For warranty purposes the wheel includes, media, desiccant coating, wheel hub, wheel rim and spokes.

O. Verification of Fit

1. Manufacturer shall verify fit of energy recovery unit and confirm fit prior to bidding. Fit is the responsibility of the manufacturer if size is other that what is shown on drawings. If unit is of different configuration than designed, then all engineering cost of redesign shall be born by ERV manufacturer. Engineer will have final say on fit after unit is installed.

P. Extra Materials

1. One set of gaskets for each door size.
2. One extra belt for wheel.

Q. Static Pressure Gauges

1. Static Pressure gauges shall be installed across filters.

R. Controls

1. Microprocessor controller: Controller shall be provided with the required sensors and programming for the preconditioner. Controller shall be factory programmed, mounted, and tested. Controller shall have an LCD readout for changing set points and monitoring unit operation. Unit shall be complete with BACNET connection.

a. Unit start command (Unit will be enabled to start once a jumper is placed between R to G)

1) Factory mounted and wired outdoor air damper actuator is powered.
2) Exhaust blower starts after a (adj.) delay.
3) Supply blower and energy wheel start after a (adj.) delay.

b. Unit stop command (or de-energized)

1) Supply blower, exhaust blower, and energy wheel de-energized.
2) Outdoor air damper actuator is spring return closed.

2. Supply Blower Sequence: The supply blower speed will be controlled with the following sequence:

a. Constant volume with VFD (on/off)

1) The supply blower is provided with a factory mounted and wired VFD and is intended to operate at a constant speed (adjustable set point in controller) during operation. This speed needs to be set during the test and balance of the unit.

3. Exhaust Blower Sequence: The exhaust blower speed will be controlled with the following sequence:

a. The exhaust and supply fans will have two speeds – medium and high. High speed will be design CFM. Low speed will be ½ of design CFM as noted on schedules. This unit will be pre-configured to receive one digital in for high speed and another digital in for low speed. This manufacturer shall coordinate with the control construction.

4. Frost Control: Frost control for the energy wheel is enabled when frost is present on the wheel; based on the outside air temperature and the pressure drop across the wheel. If the outdoor air temperature is below 5°F (adj.) and the differential pressure across the wheel is about 1/5”, frost control will enable.

a. Modulating Wheel

1) When frosting is occurring, the VFD modulates the wheel down to a slow rotational speed to defrost the wheel. Once the outdoor air temperature increases above 5°F OR the pressure drop decreases below the pressure switch set point, the unit will resume normal operation.

5. Alarms: The controller will display alarms and have one digital output for remote indication of an alarm condition. Possible alarms include:

a. Airflow Alarm

1) The controller monitors the airflow proving switch on each blower. The controller will send an alarm if either of the airflow proving switches are not engaged.

b. Temperature Sensor Alarm

1) The controller sends an alarm is the temperature sensor fails.

c. Dirty Filer Alarm

1) A digital signal is sent to the controller indicating an increased pressure drop across the outdoor, exhaust, or supply air filters which must be adjusted in the field during start up. The controller will then provide a dirty filter alarm.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is away from exhaust side to purge section to supply side.

1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
2. Access doors and panels are specified in Division 23 Section "Air Duct Accessories."

B. Arrange installation of units to provide access space around front of air-handling unit for service and maintenance.

C. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

D. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.2 CONNECTIONS

A. Comply with requirements for ductwork specified in Division 23 Section "Metal Ducts."

END OF SECTION

PAGE LEFT BLANK

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details of anchorages and attachments to structure and to supported equipment.
4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
5. Wiring Diagrams: Power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. TPI

B. Q-Mark

C. Marley

D. Redd-I

E. INDEECO

F. Sterling

G. Ouellet

2.2 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.

B. Finish: Baked enamel over baked-on primer with manufacturer's color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

D. Trim: Frames for recessed or semi-recessed installation where called for on plans.

2.4 COIL

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

A. Fan: Aluminum propeller directly connected to motor.

B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

A. Controls: Unit-mounted thermostat. Provide low-voltage relay with transformer kit where required on plans.

B. Electrical Connection: Factory wire motors and controls for a single field connection, with disconnect switch.

2.7 CAPACITIES AND CHARACTERISTICS

A. See Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall and ceiling unit heaters level and plumb.

C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Scope of Work
2. Codes and Standards
3. Coordination Between Contractors
4. Work and Workmanship
5. Drawings
6. Submittals
7. Operation and Maintenance Manuals
8. Permits
9. Minor Deviations
10. Record Drawings
11. Project Closeout
12. Guarantee
13. Inspection
14. Assignment of Miscellaneous Work
15. Materials and Equipment
16. Product and Material Approval
17. Equipment Delivery Schedule
18. Material Storage
19. Temporary Use of Equipment
20. Caulking and Fire Stopping
21. Attaching to Building Construction
22. Electrical Connections to Equipment
23. Escutcheons
24. Equipment Installation
25. Occupational Safety & Health Administration
26. Utility Services
27. Temperature Control and Building Management Systems
28. Electrical Demolition

B. Related Requirements:

1. The contractor shall thoroughly review entire bid documents, including all drawings and specifications prior to bidding and include all required electrical work in his bid, even if not shown on electrical plans and specifications.

1.2 SCOPE OF WORK

A. In addition to the requirements specified in Division 01, comply with this Article.

B. This section of Specifications contains instructions and information applicable to the electrical contractor and his subcontractors.

C. In event of conflict between the requirements in Drawings, the General Provisions, or the Specifications, the bidder shall inform Engineer of such conflict in writing not later than five days before bids are due. If such notification is not provided, Contractor shall accept Engineer's resolution of conflicts without any further compensation.

D. This Section contains a general scope of work to be performed under this contract; however, this section does not include all the work to be performed, only a general description of the project.

1. All electrical equipment indicated herein and as indicated on Drawings to make this structure electrically complete.
2. Install and connect outdoor audible alarm for fire protection system. Connect all other fire protection alarm and supervisory devices.
3. Provide electrical service entrance, capacity as shown on the plans.
4. Provide interior and exterior lighting and controls.
5. Provide wiring devices.
6. Provide electrical distribution, including panels and feeders.
7. Provide branch circuit wiring.
8. Provide connections and controls for Kitchen equipment and HVAC equipment.
9. Provide overcurrent protection.
10. Provide grounding and bonding.
11. Provide an addressable fire alarm system.
12. Provide raceways and entrance conduits for technology (CATV, Phone, Data, etc.)

E. Refer to Division 01 Section “Temporary Facilities and Controls” for temporary power requirements.

1.3 CODES AND STANDARDS

A. Materials and workmanship shall comply with Code.

B. Codes and standards shall include state laws, local ordinances, utility company regulations and requirements of nationally accepted codes and standards.

C. In case of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and contract documents, the most stringent shall govern. The contractor shall promptly notify the Engineer in writing of such difference.

D. Non-compliance: Should Contractor perform any work that does not comply with requirements of applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.

E. Building Codes: Indiana Building Code; Indiana Plumbing Code; Indiana Mechanical Code; Indiana Electrical Code and American Disabilities Act Title III, Appendix ADAAG.

F. These requirements are to be considered as a minimum and are to be exceeded when so indicated on Drawings or herein specified.

G. Industry Standards, Code and Specifications

1. ADA Americans with Disabilities Act

2.	ANSI	American National Standards Institute
3.	ASTM	American Society for Testing and Materials
4.	ETL	Electrical Testing Laboratories
5.	IEEE	Institute of Electrical and Electronics Engineers
6.	ICEA	Insulated Cable Engineers Association
7.	NECA	National Electrical Contractors Association
8.	NEMA	National Electrical Manufacturers Association
9.	NESC	National Electrical Safety Code
10.	NFPA	The National Fire Protection Association
11.	NIST	National Institute of Standards and Technology
12.	OSHA	Occupational Safety & Health Administration
13.	UL	Underwriters Laboratory Inc.

1.4 COORDINATION BETWEEN CONTRACTORS

A. Each contractor and subcontractor shall study all Drawings applicable to Work, so complete coordination between trades will be affected. Special attention shall be given to points where ducts cross other ducts or piping, where pipes, ducts and conduit pass through walls and columns, etc.

B. It is responsibility of each Contractor and Subcontractor to leave necessary room for other trades. No extra compensation will be allowed to cover the cost of removing piping, conduit, ducts or equipment found encroaching on space required by others.

C. Refer to Part 3 Article “Equipment Installation.”

D. All power outages shall be scheduled in advance with the Owner. At least two weeks advance notice is required for power transfers to allow for building user notification and scheduling.

1.5 WORK AND WORKMANSHIP

A. Provide all required labor, materials, equipment and contractor's services necessary for complete installation of systems required in full conformity with requirements of authorities having jurisdiction, all as indicated on Drawings and herein specified.

B. The finished job shall be functional and complete in every detail including all such items required for complete system, whether these items be specified or shown on Drawings.

C. Special attention shall be given to the accessibility of working and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.

D. Each contractor should acquaint himself with details of all the work to be performed by other trades and take necessary steps to integrate and coordinate his work with other trades.

E. It is assumed that the electrical contractor is familiar with standard first-class installation procedures. Therefore, the Specifications do not attempt to include every detail or operation necessary for complete installation.

F. Wherever tables or schedules show quantities of materials, they shall not be used as final count. These figures serve only as a guide to the contractor. Each contractor shall be responsible for furnishing all materials indicated on Drawings and in Specifications.

G. Electrical contractor shall be responsible for the protection, safekeeping and cleanliness of all existing equipment, material, etc. located in spaces to be remodeled in which he is working. As part of his responsibility, he shall provide necessary covers, structures, etc., as required to keep all dirt, water, moisture and dust from equipment. Method the contractor proposes to use in protecting equipment shall be coordinated with Engineer and Owner's Representative for approval before any work is started. Any damage sustained during construction shall be corrected or replaced by the electrical contractor.

H. Refer to Part 3 Article “Equipment Installation.”

1.6 DRAWINGS

A. Conduit runs are not shown on Drawings. Care shall be taken to coordinate conduit runs with piping, ductwork and other equipment to be installed by other trades. Routing of large conduits or groups of conduits shall be approved by the Engineer.

B. In general, junction boxes are not shown on Drawings. The contractor may install small junction boxes, concealed above ceilings, at his discretion if they are accessible. Large junction boxes or those exposed in walls or ceilings shall have locations approved by Engineer.

C. In general, the number of wires for electrical circuits is not shown on Drawings. A number of wires required should be installed to provide indicated functions. Verify all wiring requirements.

D. Wiring requirements for special systems may vary between acceptable manufacturers; conduit system or riser diagram shown will be that required by indicated manufacturer, but it shall be the contractor's responsibility to obtain wiring requirements from manufacturer of equipment he intends to use and include cost of this wiring in his bid.

E. Electrical work shall conform to requirements shown on Drawings. Existing structure shall take precedence over electrical drawings. Because of the small scale of electrical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Contractor shall investigate structural and finish conditions and provide such fittings and accessories as may be required to meet such conditions.

F. Refer to Part 3 Article “Equipment Installation.”

1.7 SUBMITTALS

A. In addition to the requirements in Division 01 Section “Submittal Procedures,” comply with the following requirements:

1. Review of product data and shop drawings does not relieve Contractor of responsibility for correct ordering of material and equipment. Submittals shall be reviewed by the Contractor, Engineer and Owner.

2. Include all significant data on submittals shown in specifications and on equipment schedules.
3. Contractor review should ensure that equipment will fit into available space.
4. Submit submittals in brochure form and include all related equipment in one brochure.
5. Submit six copies more than Contractor needs for his use.
6. After award of contract, submit within 30 days.
7. See individual product Sections for submittal requirements.
8. Contractor to affix his company name (in form of a stamp) and project name to all Shop Drawings and submittals before submitting.

1.8 OPERATION AND MAINTENANCE MANUALS

A. In addition to the requirements in Division 01 Section "Operation and Maintenance Data," comply with the following:

1. Contractor shall submit prior to 50 percent job completion four maintenance manuals. Manuals are to indicate all information relative to maintenance and operating instructions for all new electrical equipment.
2. Operations and Maintenance (O&M) manuals should be provided for each item of equipment. O&M submittals shall be submitted in expandable 3-ring binders. Binders shall contain enough dividers to permit an orderly filing of submittals. Each divider shall be labeled as to contents. O&M submittals shall include but not be limited to the following:

    a. Installation instructions and schematic drawings.
    b. Operating and maintenance instructions.
    c. Complete parts list with manufacturer's model numbers.
    d. Complete set of approved shop drawings.
    e. Complete wiring diagrams showing all connections and internal wiring diagrams of all equipment, including module diagrams. Factory typical wiring diagrams are not acceptable.

3. Also, as part of maintenance manuals, furnish a list of all motors used on the project with the following information: equipment served, manufacturer, horsepower, full load nameplate amps, voltage at motor, actual amp draw at full load, fuse size, overload size, type and size of starters, where fed from and how controlled.

1.9 PERMITS

A. The contractor shall pay for all permits required to carry out his work.

B. Permits shall be posted in a prominent place at the building site, protected properly from weather and physical damage.

1.10 MINOR DEVIATIONS

A. For purpose of clarity and legibility, Drawings are diagrammatic, although size and location of equipment and piping are drawn to scale wherever possible. Verify contract document information at site.

B. Drawings may indicate required sizes and points of termination and suggested routes. The Drawings do not indicate all necessary offsets. Install work in manner to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear. Do not scale from Drawings.

1.11 RECORD DRAWINGS (AS-BUILTS)

A. In addition to the requirements in Division 01 Section "Project Record Documents," comply with the following:

1. During construction, maintain a complete and legible set of Drawings, showing changes and deviations between actual construction and Engineer's Drawings. Submit marked-up sets to Engineer for review.
2. As-Built Drawings shall show ALL conduit routings, junction boxes and wiring.

1.12 PROJECT CLOSEOUT

A. In addition to the requirements in Division 01 Section "Closeout Procedures," comply with the following:

1. Contractor shall perform the following at time the building is determined to be complete and ready to turn over to Owner:

a. All burned out or inoperative lighting lamps and ballasts shall be replaced with new lamps or ballasts by this contractor.
b. All equipment and systems shall be checked by the respective contractor for correct adjustment and operation and made to function as intended.
c. All moving parts shall be lubricated, and all oil reservoirs and grease cups filled.
d. All temporary wiring, conduit, etc., shall be removed by respective contractors.

1.13 GUARANTEE

A. Unless noted otherwise, materials and equipment (excluding lamps) shall be guaranteed for a period of one year after final acceptance of the Project by the Owner.

B. Contractor agrees to make good damage to construction of building or site, or equipment which, in the opinion of the Architect/Engineer, is a result of, or incidental to, use of materials, equipment or workmanship which is inferior, defective or not in accordance with the Specifications.

C. Contractor shall keep Work in good repair during the guarantee period. In case such repairs become necessary, the Owner shall give written notice to the Contractor to commence such repairs. If after 30 days the Contractor has failed to make such repairs, the Owner may make such repairs either by its own employees or by independent contract and may thereupon recover from Contractor and his Sureties the cost of repairs so made, together with the cost of supervision and inspection thereof. Owner shall have 60 days after expiration of said guarantee period in which to notify Contractor of any such repairs necessary.

D. Determination of the necessity for repairs shall rest entirely with the Architect/Engineer whose decision upon the matter shall be final and obligatory upon the Contractor. The guarantee herein stipulated shall extend to whole body improvement and all its appurtenances.

E. Include the guarantee in the Operation and Maintenance Manual.

1.14 INSPECTION

A. At the completion of the electrical installation, the electrical contractor shall notify the local and state authorities to arrange the final inspection of Work. Include the inspection certificate in the Operation and Maintenance Manual.

1.15 UTILITY SERVICES

A. Electrical Energy Utility serving the Project is: Duke Energy.

B. Coordination

1. It is the responsibility of the contractor to coordinate with the utility company prior to bid and determine responsibility for wire and conduit, metering, excavation, concrete pads and any other similar items.
2. Should the regulations of the utility company conflict with these specifications, then the regulations of the utility company shall dictate the method of installation.
3. In the event that the contractor fails to verify these details with the utility company, no reimbursements for changes in service will be made.

C. Electrical Energy Utility

1. Electrical service to be provided at 120/208 volts, 3-phase, 4-wire, wye connected, 60 Hertz, alternating current.
2. All primary service wire will be furnished and installed by the utility company. If a paved surface will cover the service, the electrical contractor shall provide conduit for the utility company’s use beneath the paved surface.
3. Secondary service entrance wire and conduit shall be furnished and installed by the electrical contractor.
4. The utility company will provide a 3-phase pole mounted transformer bank and make all terminations at the transformer.
5. The contractor will be responsible for trenching and backfilling of the secondary feeder. The utility company shall be responsible for trenching and backfilling of the primary feeder.
6. The contractor will provide a 1-1/2-inch conduit from the CT cabinet to the metering cabinet. The metering cabinet will be furnished by the utility company and installed by the contractor. The contractor shall provide a utility-approved CT cabinet.

D. Telephone, Broadband, and Cable Television Utilities

1. Obtain from the local telephone, broadband, and cable television utility companies an estimate of the billable expenses that the utility company expects to incur on this project

and include this price in your bid. The successful bidder shall pay these charges and shall include all requirements needed for this project by the power company.

2. The contractor shall install the telephone, broadband, and cable television enclosure, conduit, cable and trench complete as directed by the local utility companies.
3. Provide ground wire and ground rod and connect to the building grounding system at the main entrance.

PART 2 - PRODUCTS

2.1 ASSIGNMENT OF MISCELLANEOUS WORK

A. Excavating and backfilling for electrical work shall be by electrical contractor.

1. Properly support banks of excavation with safety sheet pile. Install necessary guards. Provide adequate pumping equipment and keep excavation free of water.
2. Excavate pipe trenches to proper depth. Where rock is encountered, excavate to 6 inches below pipe and refill to 6 inches above pipe with compacted granular fill. Granular fill shall consist of dune sand, gravel or other suitable material containing not more than 10 percent by weight passing #200 sieve and 100 percent passing 1-inch sieve.
3. Excavation for utilities shall not be backfilled until all required tests are performed and approved by the Engineer and the utility company.
4. Whenever underground feeders are run below footings and grade beams, contractor shall backfill the void with poured, steel-reinforced concrete to elevation of bottom of footing or grade beam.
5. Backfill within building lines shall be made with granular fill or compacted backfill material laid in 6-inch layers and tamped to specified compaction after each layer.
6. The backfill under paved area shall be made with granular fill compacted backfill material laid in 12-inch layers and tamped to compaction after each layer.
7. Backfill under open yards or fields shall be made with non-compacted backfill laid in layers not to exceed 24 inches deep. Sand trenches may be allowed to settle naturally and shall be refilled back to grade as required during first year after final acceptance.
8. The contractor shall refill, regrade and refinish any area that becomes unsatisfactory due to settlement within one year after final acceptance.
9. Contractor shall verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to any trenching, excavation or underground installation. In event existing conditions are such as to prevent installation in accordance with Drawings, contractor shall immediately notify Engineer.
10. Provide appropriate plastic marker tape buried directly above underground electric and communication lines continuously along length of lines. Marker tape shall be located 12 inches below finished grade, but no closer than 12 inches above underground lines. Tape shall be a minimum of 6 inches wide.
11. Refer to Division 31 Section “Earth Moving,” for additional requirements. In event of conflict between this section and Division 31 Section “Earth Moving,” Division 31 Section “Earth Moving” shall apply, unless otherwise indicated by Engineer.

B. Roof openings and flashing required by electrical contractor shall be the responsibility of the electrical contractor; however, all roofing work shall be performed by the roofing contractor. The electrical contractor is responsible for correct size and location of openings. Counterflashing shall be provided by the electrical contractor.

1. Coordinate exact roofing material and approved penetrations with the general contractor prior to the installation of penetrations. Provide components and installation as specified below or as directed by the general contractor.
2. Conduit Roof Penetration Curb:

    a. The curb shall be prefabricated pipe portal type with molded cover from ABS plastic with laminated acrylic coating. Rubber seal cap to accommodate pipe sizes listed on drawings. Seal cap shall be compression molded of EPDM rubber with high resistance to both ozone and ultraviolet sun rays. Fasteners shall be stainless steel snaplock swivel action clamps and shall fasten pipe molded cover to form a watertight seal.
    b. Conduit roof penetrations may be grouped with other electrical conduits, HVAC piping, and plumbing piping where penetrations of roof are in the same area. Coordinate other trade penetrations with the mechanical contractor and the plumbing contractor.
    c. Where electrical equipment is to be installed on the roof to serve rooftop units, condensing units, or other equipment, provide the following:

        1) The electrical contractor shall provide supports constructed of minimum 1-inch rigid conduit, bolted or welded to roof structural system, extending through roof prefabricated curb and permanently attached to electrical equipment. Install electrical equipment 1'-6" above roof to bottom of equipment unless otherwise noted.
        2) Manufacturer: Subject to compliance with above requirements, provide pipe roof penetration curb from one of the following: Pate Curb Co.; Roof Products and System Corporation.

C. Concrete pads and bases for electrical work shall be formed and poured by the electrical contractor. The electrical contractor shall install all anchoring devices.

1. Unless noted otherwise, 4-inch pads projecting 3 inches on all sides beyond equipment shall be used for switchboards, control centers, unit substations, motor controllers, etc. Set bolts in pipe sleeves from templates or actual measurements. Set equipment level and grout in place. Anchor equipment to pad.
2. Concrete used on this project shall have maximum slump of 4 inches and shall attain 3000 psi compressive strength after 28 days. Smooth out all rough edges and surfaces.

D. Platforms and supporting stands for electrical equipment shall be furnished by the electrical contractor.

1. Each piece of equipment or apparatus suspended from ceiling or mounted above floor level shall be provided with suitable structural support, platform or carrier, in accordance with best recognized practice.
2. Contractor shall exercise extreme care that structural members of building are not overloaded by such equipment. In all cases, details of such hangers, platforms and supports, together with total weight of mounted equipment, shall be approved by Engineer.

E. Cutting and patching for electrical equipment shall be by the electrical contractor.

1. Cut structural materials where required after approval from Architect/Engineer.
2. The electrical contractor shall provide all his own cutting and patching in finished areas.

F. Ceiling and wall access panels for electrical equipment shall be furnished and installed by the electrical contractor.

1. Wherever any electrical outlet, junction box, or item of equipment is concealed or enclosed above or behind walls, ceilings, floors, bulkheads, etc., an access panel or door shall be provided.
2. When access through acoustic tile ceiling is required, this shall be accomplished wherever possible by use of removable ceiling tiles.
3. All access panels, doors and removable ceiling tiles required for electrical equipment shall be provided and installed by the contractor as required and as approved by the Engineer.
4. Access panels or doors shall be of design suitable to the type of construction at each location. Locks shall be flush, screwdriver-operated, cam action type. Doors and frames shall be furnished in prime coat of gray, rust-inhibitive paint unless otherwise specified. These units shall be manufactured by Milcor or approved equal.

G. Lintels required by the electrical contractor shall be furnished by the electrical contractor. Electrical contractor shall notify the general contractor of correct location for all lintels prior to wall construction.

H. Sleeves and small openings (not framed) for electrical equipment shall be furnished and set by the electrical contractor.

1. Where electrical conduits pass through walls, roofs, ceilings, or floors, electrical contractor shall have sleeves set for them when floors, walls, ceilings or roofs are constructed. If any holes are cut in finished work where sleeves have been omitted, cutting shall be done with a concrete coring machine or other approved means and only with consent of Engineer. All such holes are to be carefully cut and shall not be larger than necessary. These holes are to be entirely covered by escutcheon plates when work is completed. Sleeves shall be made of pipe or rolled sheet steel no lighter than No. 18 gauge.
2. Where conduits pass through sleeves in exterior walls above grade, annular space shall be caulked with oakum and filled inside and out with non-hardening, waterproof sealant finished off flush with both faces of wall.
3. Provide penetration seals for all conduits penetrating the building wall below grade. This shall include service entrance, site power and lighting circuits, etc.

    a. Description: The pipe to wall penetration closures shall be "Link-Seal" or equal, as manufactured by PSI/Thunderline Corporation – Houston, TX. Seals shall be modular type, consisting of synthetic rubber shaped to continuously fill the annular space between the pipe and wall opening. After the seal assembly is positioned in the sleeve, the rubber sealing elements shall provide a water-right seal between the pipe and wall opening. The seal shall be constructed to provide electrical insulation between the pipe and wall, thus reducing changes of cathodic reaction between these two members.
    b. Wall Opening: Provide “Century-Line” sleeves or equal as manufactured by PSI/Thunderline Corporation – Houston, TX. Contractor shall determine the required inside diameter of each individual wall opening of sleeve before ordering, fabricating or installing. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and Link-Seal to assure a water-tight joint. Sizing (correct Link-Seal model and number of links per seal) may be obtained through manufacturer's catalog. If the pipe O.D is non-standard due to

coating, insulation, etc. consult Thunderline's factory for engineering assistance and recommendation before proceeding with wall opening detail.

I. Holes through Structural members: Holes required for conduit of size 5-inches and smaller shall be cut in field at expense of electrical contractor. Obtain structural engineer’s approval in writing prior to any cutting.

J. Pitch Pockets: Required for conduit penetrating roof by electrical contractor. Electrical contractor to seal sleeves and provide flashing.

K. Color Coding: Responsibility for correct color coding shall be by the electrical contractor.

L. Dust Protection: Temporary partitions or barriers required to protect existing buildings or facilities shall be provided by electrical contractor. Electrical contractor shall coordinate necessity and location of such protection with Owner.

M. Painting of electrical equipment, conduits, etc., shall be in accordance with painting part of the Specification. Painting shall be by others, except as indicated below, who will paint work of electrical contractor; however, each contractor shall thoroughly clean all his own equipment, apparatus and piping in manner satisfactory to Architect and Owner. Equipment furnished with factory applied finish shall be protected from injury and any damaged surface shall be repaired by an electrical contractor to match original finish or shall be replaced before final acceptance. The electrical contractor shall provide color-code painting as required to comply with Division 26 Section “Identification for Electrical System.”

2.2 MATERIALS AND EQUIPMENT

A. Electrical equipment shall be new, listed by UL and shall conform to NEMA and ICEA standards.

B. Materials used for a similar service shall be by the same manufacturer (i.e., all motor starters to be by same manufacturer).

C. All materials and equipment, including any hangers, supports, fastenings or accessory fittings, shall have corrosion protection suitable for the atmosphere in which they are installed, whether located indoors or out. Care shall be taken during installation to assure integrity of corrosion protection.

D. All screws, bolts, nuts, clamps, fittings or other fastening devices shall be made tight. All bolts, screws, nuts and other threaded devices shall have standard threads and heads so they may be installed and replaced when necessary, without special tools.

2.3 PRODUCT AND MATERIAL APPROVAL

A. A Specification followed by one or more manufacturers is limited to those manufacturers. Names of other manufacturers may be submitted for approval to Engineer a minimum of ten (10) days prior to receiving bids. Approval will be issued by Addendum if granted.

B. A Specification followed by one or more manufacturers and "or approved equal" is open to all equal products or materials; however, Contractor shall supply one of listed manufacturers at no additional cost if Engineer finds substituted product unsatisfactory.

2.4 EQUIPMENT DELIVERY SCHEDULE

A. Submit upon request a schedule listing equipment and materials required for complete installation, quantity ordered, date of placing order and promised delivery date.

2.5 MATERIAL STORAGE

A. Provide suitable protection from weather and vandalism for all materials and equipment to be installed. Storage shall be dry, clean and safe. Any materials or equipment damaged, deteriorated, rusted or defaced due to improper storage shall be fully repaired, refinished or replaced as directed by the Engineer.

2.6 TEMPORARY USE OF EQUIPMENT

A. Should it become necessary or desirable to operate any equipment before final acceptance, Owner shall be allowed to do so, but only after proper adjustment and trial operation by contractor specified. Electrical contractor shall be responsible for instructing Owner or his Representative as to proper operation and care of equipment so used. The owner shall be responsible for proper care and supervision of equipment before acceptance and shall safeguard same in every way.

2.7 CAULKING AND FIRESTOPPING

A. In addition to the requirements in Division 07 Section “Penetration Firestopping,” comply with this Article.

B. All raceway and sleeve penetrations of fire barriers shall be sealed to achieve fire resistance equivalent to fire separation.

1. Maintain fire rating per ASTM E-814 and UL 1479.
2. This assembly must also maintain a watertight seal between floor or wall and pipe.

C. For other penetrations through non-rated walls, partitions, floors and ceilings, caulk the space between raceways and raceway sleeves with non-staining, waterproof gun grade compound. Apply caulking compound by the gun method using nozzles of a proper size to fit the width of joint. Prepare the joint for caulking by packing it tightly with a resilient foam or rope yarn.

D. Products: Subject to compliance with requirements, provide one of the following:

1. Penetration sealant:

a. 3M Brand "Moldable Putty Pads": and "Moldable Putty Stix"
b. 3M Brand "Fire Barrier" Caulk, Putty or Penetrating Sealing Systems
c. Dow Corning "Fire Stop Foam: and "Fire Stop Sealant" systems

d. Insta-Foam Products, Inc. "Insta-Fire Seal Silicone RTV Foam"
e. Standard Oil Engineering Materials Company, "Frye Putty"
f. Chase technology "Chase Foam #CTC PR-855"

2. Intumescent Sealant for use at openings and sleeves involving flexible cable.

a. 3M Brand "Fire Barrier" caulk or putty, FS-195 Wrap Strip and CS-195 Composite Sheet.
b. Dow Corning "Fire Stop Intumescent Wrap Strip"
c. Fox Couplings, Inc. "The Fox Cast-in-Place Coupling"

E. Performance Characteristic: Firestopping materials shall conform to both Flame (F) and Temperature (T) ratings as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test.

1. F Rating shall be a minimum of one hour but not less than the fire resistance rating of the assembly being penetrated.
2. Conduct the fire test with a minimum positive pressure differential of 0.01 inches of water column.

F. Quality Assurance: Installer qualifications – a firm specializing in firestopping installation with not less than two years of experience or training and approved by firestopping manufacturer.

PART 3 - EXECUTION

3.1 ATTACHING TO BUILDING CONSTRUCTION

A. Equipment raceway supports shall be attached to structural members (beams, joists, etc.) rather than to floor or roof slabs. Do not attach to ceiling support wires.

B. Where equipment and raceway are suspended from existing concrete or masonry construction, use expansion shields to attach supports to construction. Expansion shield bolt diameter shall be same size as support rod diameter, hereinafter specified. Expansion shields shall be Star Double, Star Gloxin, Star Loxin or approved equal.

C. Where existing masonry is not suitable to receive and hold expansion shield or where other means of attachment is advantageous, Contractor shall submit alternate method for approval by Engineer.

D. Equipment to be installed in groups shall not be mounted directly to masonry or concrete walls. Mount 1- by 1-inch structural channel such as Unistrut, to wall and secure equipment to these channels.

E. Where raceways are suspended from structural steel building framing or supporting members, furnish and install beam clamps for attaching piping device to building member.

F. Obtain approval from Owner and structural engineer before cutting or welding to structural members, or before hanging heavy equipment.

3.2 ELECTRICAL CONNECTIONS TO EQUIPMENT

A. If supplier requires larger starter or disconnect than those indicated on documents, he shall reimburse contractor supplying these items for difference.

B. Connections and wiring diagrams shown on Drawings or described in Specifications are typical and are for bidding purposes only. Detailed diagrams and instructions shall be provided by the contractor supplying equipment if connections are different from those shown on Drawings. Diagrams shall be submitted to the Engineer for review prior to actual wiring.

C. Additional relays, switches, contactors, etc., which may be required for control purposes in addition to those specified for and indicated on Drawings, shall be provided by an electrical contractor. These devices shall be mounted by supplier within 5-feet of apparatus to be installed. Electrical contractor shall provide all additional wire and electrical connections without additional charge to Owner.

3.3 ESCUTCHEONS

A. Install chrome plated escutcheons on exposed bare conduit, leaving and entering walls, floors, ceilings, etc.

3.4 EQUIPMENT INSTALLATION

A. All equipment must be installed such that maintenance and service may be properly accomplished. If necessary, the Owner, at their option, may require the contractor to demonstrate the service on any piece of equipment to determine sufficient service space exists. If the service space is not adequate, the equipment shall be relocated at no additional cost to the Owner such that sufficient service space is achieved.

3.5 OCCUPATIONAL SAFETY & HEALTH STANDARDS

A. All work shall comply with current requirements of U.S. Department of Labor-Occupational Safety & Health Administration, entitled Occupational Safety and Health Standards; National Consensus Standards and Established Federal Standards.

3.6 TEMPERATURE CONTROLS AND BUILDING MANAGEMENT SYSTEMS

A. Electrical contractor shall provide power wiring for temperature control panels and shall coordinate and verify locations and quantities with temperature controls contractor. (No extra will be paid for any panels because electrical contractor did not coordinate with temperature controls contractor.)

B. The wiring required to connect the electrical control devices and temperature control panels specified in the Mechanical Sections, including wiring for switches, freeze-stats, limit controls, relays, flow and pressure switches, etc., will be provided under Mechanical Sections. Interlock wiring specified in mechanical Sections shall be provided under mechanical Sections. The electrical contractor shall provide the 120 volts only.

C. Electrical Contractor shall provide device box and conduit to above accessible ceiling for thermostats and sensors furnished by temperature control contractor or the mechanical contractor.

3.7 ELECTRICAL DEMOLITION

A. In addition to the requirements in Division 02 Section "Selective Demolition," comply with this Article.

1. Scope of Work: Provide demolition required for removal of systems and equipment made obsolete by this Project and as determined by the Architect/Engineer.
2. Work Included:

    a. Non-destructive removal of systems, materials, and equipment for reuse or salvage as shown on Drawings or requested by Owner.
    b. Removal of all debris from site and legal disposal of same.
    c. Removal of all abandoned or obsolete exposed materials and equipment for a clean and finished installation.
    d. Removal of all abandoned or obsolete raceways, wiring, cabling, or electrical devices of any kind.

B. Conditions

1. Coordination: It shall be expected that the Contractor understands that adjacent areas need to remain in operation and that services to these areas need to be maintained. A schedule will be worked out prior to beginning work and as many criteria for operation as possible will be explained. Contractor cooperation shall be expected in all conditions.
2. Phasing:

    a. Prior to commencing demolition in any area of the work, notify the Owner and Architect/Engineer five (5) working days in advance to insure that no adjacent occupied areas will be disrupted.
    b. Demolition phasing must be approved by Architect/Engineer prior to commencement of operations.
    c. Removal of debris and construction traffic will be limited to specified areas. Confirm all operations with Architect/Engineer prior to commencement of work.

3. Adjacent Materials:

    a. During the execution of the work, primary consideration shall be given to protecting from damaging the structure, furnishings, finishes, and the like which are not specifically indicated to be removed and disposed of.
    b. Provide and maintain temporary partitions or dust barriers adequate to keep dirt, dust, noise and other particles from being transferred to adjacent areas.
    c. Existing items or surfaces to remain which are damaged because of this work shall be refinished, repaired, or replaced to the satisfaction of the Architect/Engineer and Owner at no additional cost.

C. Materials

1. Patching: Materials used for patching shall be in conformance with the applicable sections of the Project Manual. Where materials are not specifically described but required for proper completion of the work, they shall be as selected by the Contractor subject to approval of the Architect/Engineer. Materials used and workmanship shall match surrounding areas as much as possible, unless otherwise directed.

D. Demolition

1. Site Inspection

   a. The Contract Documents do not propose to show all systems, materials, or equipment existing on the project that will require demolition.
   b. Before commencing the work of this Section, verify with the Architect/Engineer and Owner all systems, materials, and equipment to be removed and those to be preserved.

2. Scheduling

   a. Schedule all work in a careful manner with all necessary considerations for public and adjacent areas.
   b. Avoid interference with the use of adjacent areas and passage to and from these areas.

3. Abandoned Materials and Equipment: Items so indicated on Contract Documents to be removed and not indicated or specified to be saved or retained, shall be demolished, removed, demounted, or disconnected in the best possible manner to ensure that no damage will result to other adjacent items or surfaces to remain.
4. Salvage

   a. During removal of items so indicated, caution shall be used to eliminate damage to any equipment having salvage value.
   b. All reusable salvaged material shall remain the property of the Owner and be retained for his inspection. Only items so inspected and rejected by the Owner shall be disposed of by the Contractor. All other such items shall be turned over and deposited as directed by the Owner.

5. Disposal and Clean Up

   a. Areas in which demolition and salvage work is being done shall be cleaned daily.
   b. Dirt, dust, debris, unsalvageable and reusable items, and the like shall be totally removed from the project site daily. Under no circumstances shall such refuse be allowed to collect for longer periods.
   c. Refuse shall not be allowed to block, or otherwise impair, circulation in corridors, stairs, sidewalks, or other traffic areas.

6. Existing Facilities

   a. Where existing equipment or materials are removed or changed, all branch conduits, which no longer are in service, shall be removed as directed by the Engineer. If, in the course of work, outlets are covered up, or otherwise rendered inaccessible, all wiring to same shall be removed to source. If the circuit that must remain in service

is interrupted, it shall be reconnected by the most inconspicuous means so as to remain operational, with same capacity as before. All building surfaces damaged and openings left by removal of boxes, piping and other equipment shall be repaired by Contractor. Holes left in junction boxes, switches, panels, etc. shall be closed.

b. Where new openings are cut and concealed conduits, wiring, etc. are encountered, they shall be removed or relocated as required. Where conduit to be removed stubs through floors, walls and ceilings, such conduit shall be removed to a point where finish surfaces can be patched adequately so that no evidence of former installation remains. Patching and refinishing required shall be the responsibility of Contractor.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2 and Type SO.

C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC and Type SO with ground wire.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper.

B. Branch Circuits: Copper.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, or single conductors in raceway; or metal-clad cable, Type MC.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN-2-THWN-2, single conductors in raceway, or metal-clad cable, Type MC.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway, or metal-clad cable, Type MC.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway, or metal-clad cable, Type MC.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN-2-THWN-2, single conductors in raceway, or metal-clad cable, Type MC.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conduit Fill: Unless otherwise indicated, install no more than the following in a single conduit or EMT:

1. Single-Phase Circuits: Three circuits, phases A, B, and C, and associated grounded (neutral) conductors, and equipment grounding conductor.
2. Three-Phase Circuits: One circuit, phases A, B, and C, and grounded conductor where applicable, and equipment grounding conductor.

B. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

C. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

B. Make splices, terminations, and taps that are compatible with conductor material.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to these bid documents.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. Harger Lightning and Grounding.
4. ILSCO.
5. O-Z/Gedney; A Brand of the EGS Electrical Group.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Uninsulated Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install uninsulated tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 ACTION SUBMITTALS

A. Product Data: For steel slotted support systems.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Not permitted.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

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

        1) Cooper B-Line, Inc. a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Steel Slotted Support Systems: Select material suitable for environmental conditions.

1. Outdoors: Metallic coated.
2. Corrosive Locations (Swimming Pools, Dishwashing): Nonmetallic coated.
3. Indoors: Painted.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete" or Division 03 Section "Miscellaneous Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 Section "Exterior Painting," Division 09 Section "Interior Painting," and Division 09 Section "High Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

1.2 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. IMC: Comply with ANSI C80.6 and UL 1242.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. FMC: Comply with UL 1; zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel. Die-cast is not permitted.
b. Type: Setscrew or compression.

H. Joint Compound for IMC and GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. RNC: Type EPC-40-PVC and Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Continuous HDPE: Comply with UL 651B.

D. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

E. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable or semi-adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular as indicated.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

M. Gangable boxes are prohibited.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic or fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

1. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC.".

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
3. Underground Conduit: RNC, Type EPC-80-PVC, direct-buried.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC maximum 6-foot length.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Physical Damage: GRC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Electrical rooms.
    e. Utility tunnels.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Concealed in Exterior Walls: RNC, Type EPC-40-PVC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations, maximum 6-foot length.
6. Damp or Wet Locations: GRC or IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum boxes or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit. Support within 12 inches of changes in direction.

F. Conceal conduit and EMT within finished walls, ceilings, and below floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches of enclosures to which attached.

H. Raceways Embedded in Slabs: Not permitted.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

L. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

M. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

N. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

O. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

Q. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

R. Locate boxes so that cover or plate will not span different building finishes.

S. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

T. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

U. Set metal floor boxes level and flush with finished floor surface.

V. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line, 30 inches below grade.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Grout.
4. Silicone sealants.

B. Related Requirements:

1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.

b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. GPT Industries.
d. Metraflex Company (The).
e. Pipeline Seal and Insulator, Inc.
f. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Reinforced nylon polymer.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for conductors.
2. Underground-line warning tape.
3. Warning labels and signs.
4. Instruction signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

A. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.2 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

    a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.
    b. Overall Thickness: 5 mils.
    c. Foil Core Thickness: 0.35 mil.
    d. Weight: 28 lb./1000 sq. ft.
    e. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Screw-attached, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

1. Self-Adhesive equipment identification labels are not permitted.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

D. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coded conductor insulation to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

a. Color shall be factory applied.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Common Neutral: White.
5) Neutral, Phase A: White with black stripe.
6) Neutral, Phase B: White with red stripe.

7) Neutral, Phase C: White with blue stripe.
8) Equipment Grounding Conductor: Green.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Common Neutral: Gray.
5) Neutral, Phase A: Gray with brown stripe.
6) Neutral, Phase B: Gray with orange stripe.
7) Neutral, Phase C: Gray with yellow stripe.
8) Equipment Grounding Conductor: Green.

d. Field-Applied, Color-Coding Conductor Tape: Not permitted.

B. Install instructional sign including color-code for grounded and ungrounded conductors using adhesive-film-type labels.

C. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

F. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.

b. Controls with external control power connections.

5. For service equipment: Provide label complying with Article 110.16(B) including voltage, available fault current, DCPD clearing time, and date applied.

H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Stenciled legend 4 inches high.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electronic time switches.
2. Electromechanical dial-time switches.
3. Photoelectric switches.
4. Indoor occupancy sensors.
5. Switchbox-mounted occupancy sensors.
6. Outdoor motion sensors.
7. Room controllers.
8. Lighting contactors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy sensors
b. Room Controllers

2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

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

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC; TORK Products.

6. TE Connectivity Ltd.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 40-A inductive or resistive, 120/277-V ac.
4. Programs:

a. Two on-off set points on a 24-hour schedule, allowing different set points for weekdays and weekends, with astronomic time function.

1) On at sunset; off at Owner specified curfew.
2) On at Owner specified on-time; off at sunrise.

5. Automatic daylight savings time changeover.
6. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.
7. Enclosure: Metal, indoor/outdoor.

2.2 ELECTROMECHANICAL DIAL-TIME SWITCHES

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

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC; TORK Products.
6. TE Connectivity Ltd.

B. Electromechanical-Dial Time Switches: Comply with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 30-A inductive or resistive, 120/277-V ac.
4. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.
5. Enclosure: Metal, indoor/outdoor.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

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

1. Cooper Industries, Inc.

2. Intermatic, Inc.
3. NSi Industries LLC; TORK Products.
4. Tyco Electronics; ALR Brand.

B. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.
5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.4 INDOOR OCCUPANCY SENSORS

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

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Intermatic, Inc.
4. Leviton Mfg. Company Inc.
5. Lithonia Lighting; Acuity Lighting Group, Inc.
6. Lutron Electronics Co., Inc.
7. Sensor Switch, Inc.
8. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack. Provide optional dry contacts for interface to Building Automation Systems, where required by Division 23 for control of equipment.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.
b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.

E. Multi-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.5 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

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

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Intermatic, Inc.
4. Leviton Mfg. Company Inc.

5. Lithonia Lighting; Acuity Lighting Group, Inc.
6. Lutron Electronics Co., Inc.
7. Sensor Switch, Inc.
8. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.
2. Sensing Technology: PIR.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Dual voltage, 120 and 277 V type.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.6 ROOM CONTROLLERS

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

1. Hubbell Building Automation, Inc.
2. Leviton Mfg. Company Inc.
3. Watt Stopper.

B. System Description: Sensing occupancy, the system adjusts the indoor electrical lighting levels.

1. General lighting control set point is based on lighting conditions:

a. When no occupancy is present, dim to 20 percent output.
b. When occupancy is present, full output.
c. When room switch is off, general lighting is off

2. Night Light (NL) control set point is based on lighting conductions

a. When no occupancy is present, dim to 20 percent output.
b. When occupancy is present, full output.
c. When room switch is off, night lighting is on 20 percent output.

C. Electrical Components, Devices and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.

D. Description: Six scene digital controller capable of accepting three (3) RJ45 inputs with two (2) outputs rated for 20-A LED load at 120- and 277-V ac. Sensor has 24-V dc Class 2 power source, as defined by NFPA 70. Controls 0- to 10-V dc dimming drivers.

2.7 OUTDOOR MOTION SENSORS

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

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Intermatic, Inc.
4. Leviton Mfg. Company Inc.
5. Lithonia Lighting; Acuity Lighting Group, Inc.
6. NSi Industries LLC; TORK Products.
7. RAB Lighting.
8. Sensor Switch, Inc.
9. Watt Stopper.

B. General Requirements for Sensors: Solid-state outdoor motion sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. PIR type, weatherproof. Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. Comply with UL 773A.
3. Switch Rating:

a. Lighting-Fixture-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent.
b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

4. Switch Type: SP, dual circuit.
5. Voltage: Dual voltage, 120- and 277-V type.
6. Detector Coverage:

a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft.
b. Long Range: 180-degree field of view and 110-foot detection range.

7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.8 LIGHTING CONTACTORS

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

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Corporation.
4. General Electric Company; GE Consumer & Industrial – Electrical Distribution; Total Lighting Control.
5. Square D; a brand of Schneider Electric.

B. Description: Electrically operated and mechanically or electrically held as indicated on Drawings, combination-type lighting contactors with, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.9 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19 "Electrical Power Conductors and Cables."

B. Control Cable: Comply with requirements in Section 26 05 23 "Control-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

B. Sensor Spacing:

1. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
2. Lighting Fixtures: Locate detectors no closer than 12 inches from any part of a lighting fixture.

C. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

D. Wiring Method: Comply with Section 260519 "Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.

E. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Engage a factory-authorized service representative to test and inspect components, assemblies and equipment installations, including connections of room controllers.

3.3 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two (2) visits to Project during other normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time-delay to suit Owner’s operations.
2. For room controllers, adjust set points and deadband controls to suit Owner’s operations.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate and maintain lighting control devices.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Panelboard schedules for installation in panelboards.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box with continuous piano hinge and standard door within hinged trim cover.
4. Directory Card: Inside panelboard door, mounted in card holder with metal frame and transparent plastic window.

B. Incoming Mains Location: Top and bottom.

C. Phase, Neutral, and Ground Buses: Tin-plated aluminum or hard-drawn copper, 98 percent conductivity.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum or hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression or mechanical type.
3. Ground Lugs and Bus Configured Terminators: Compression or mechanical type.
4. Feed-Through Lugs: Compression or mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Sub-feed (Double) Lugs: Compression or mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

1. Series-ratings are not permitted.

2.2 DISTRIBUTION PANELBOARDS

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Mains: Circuit breaker, fused switch, or lugs only, as indicated on Drawings.

D. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

E. Branch Overcurrent Protective Devices: Fused switches.

F. Arc Energy Reduction: Energy reducing maintenance switch that allows the worker to set the main overcurrent protective device and feeder overcurrent protective devices rated 1200 amperes and larger to “no intentional delay” to reduce the clearing time while a worker is within an arc-flash boundary.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only, as indicated in Drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Compression or mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 26 28 13 "Fuses."

2.5 SURGE PROTECTION DEVICES

A. SPDs: Comply with UL 1449, Type 1.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Include LED indicator lights for power and protection status.
3. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

C. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V.
2. Line to Ground: 1200 V.
3. Neutral to Ground: 1200 V.
4. Line to Line: 2000 V.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

E. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

F. SCCR: Equal or exceed 200 kA.

G. I Nominal Rating: 20 kA.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

B. Mount top of trim 79 inches above finished floor unless otherwise indicated.

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

H. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. USB charger devices.
3. Weather-resistant receptacles.
4. Snap switches and wall-box dimmers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Arrow Hart/Eaton (Arrow Hart).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, One -piece solid brass mounting strap. 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; 5361 (single), AH5362 (duplex).
b. Hubbell; HBL5361 (single), HBL5362 (duplex).
c. Leviton; 5891 (single), 5362 (duplex).
d. Pass & Seymour; 5361 (single), 5362-A (duplex).

B. Tamper-Resistant Convenience Receptacles, One-piece solid brass mounting strap. 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; AHTR5362.
b. Hubbell; HBL5362TR.
c. Leviton; 5362-SG.
d. Pass & Seymour; TR63.

2.4 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles: 5 V dc, 3.1 A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; TR7756.
b. Hubbell; USB20X2.
c. Leviton; T5832.
d. Pass & Seymour; TR5362USB.

2. USB Receptacles: Two, Type A.
3. Line Voltage Receptacles: Two, two pole, three wire, and self-grounding.

B. Tamper-Resistant, Hospital Grade, USB Charger Receptacles: 5 V dc, 3.1 A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; TR8355.
b. Hubbell; USB8300.
c. Leviton; T5832-HG.
d. Pass & Seymour; TR8300HUSB.

2. USB Receptacles: Two, Type A.
3. Line Voltage Receptacles: Two, two pole, three wire, and self-grounding.
4. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.5 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943 Class A.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; SGF20.
b. Hubbell; GFRST20.
c. Pass & Seymour; 2097.
d. Leviton; GFNT2-.

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; TRSGF20.
b. Hubbell; GFTRST20.
c. Pass & Seymour; 2097TR.
d. Leviton; GFTR2-.

D. Weather-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; WRSGF20.
b. Hubbell; GFWRST20.
c. Pass & Seymour; 2097TRWR.
d. Leviton; GFWR2-.

E. Weather- and Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; TWRSGF20.
b. Hubbell; GFTWRST20.
c. Pass & Seymour; 2097TRWR.
d. Leviton; GFWT2-.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; CWL520R.
b. Hubbell; HBL2310.
c. Leviton; 2310.
d. Pass & Seymour; L520-R.

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Single Pole:

1) Arrow Hart; AH1221.
2) Hubbell; HBL1221.
3) Leviton; 1221-2.
4) Pass & Seymour; PS20AC1.

b. Two Pole:

1) Arrow Hart; AH1222.
2) Hubbell; HBL1222.

3) Leviton; 1222-2.
4) Pass & Seymour; PS20AC2.

c. Three Way:

1) Arrow Hart; AH1223.
2) Hubbell; HBL1223.
3) Leviton; 1223-2.
4) Pass & Seymour; PS20AC3.

d. Four Way:

1) Arrow Hart; AH1224.
2) Hubbell; HBL1224.
3) Leviton; 1224-2.
4) Pass & Seymour; PS20AC4.

2.9 SPRING-WOUND INTERVAL TIME SWICHES

A. Spring-Wound Countdown Timer: Single-pole, single-throw, 125-277 V ac, rated 20 A at 125 V ac and 10 A at 277 V ac, without hold function.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Intermatic model FF2H.

2.10 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper Wiring Devices; Skye series.
b. Leviton, Renoir II series.
c. Lutron, Nova T series.
d. Pass & Seymour; Titan series.
e. Philips, Sunrise series.

B. Control: Continuously adjustable slider; with single-pole or three-way preset switching. Comply with UL 1472.

C. LED Lamp Dimmer Switches: Rated 8 A at 120 V and 5 A at 277 V, 0-10 V dc control, modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 10 percent of full brightness.

2.11 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, extra-duty, while-in-use, die-cast aluminum with lockable cover.

2.12 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, and flap-type, and above-floor, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular and round, die-cast aluminum and solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Section 271500 "Communications Horizontal Cabling."

2.13 POKE-THROUGH ASSEMBLIES

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

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold/Legrand.

B. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks complying with requirements in Section 271500 "Communications Horizontal Cabling."
4. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
6. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 27 15 00 "Communications Horizontal Cabling."

2.14 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
10. Install adjacent devices in multi-gang boxes under common device plates.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

I. Adjust locations of floor service outlets, poke-through assemblies, and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Cartridge and plug fuses rated 600-V ac and less and spare fuse cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA FU 1 for cartridge fuses.

C. Comply with NFPA 70.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Bussmann; Eaton, Electrical Sector.
2. Edison Fuse, Inc.
3. Littelfuse, Inc.
4. Mersen USA.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable, rejection base plug fuses rated 125 V ac.

2.4 SPARE FUSE CABINETS

A. Cabinet: Wall-mounted, 0.05-inch-thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
4. Fuse Pullers: For each size of fuse.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay.
2. Feeders, 600 A or Less: Class RK1, time delay.
3. Feeders, 601 A or Greater: Class L, time delay.
4. Motor Branch Circuits: Class RK1, time delay.
5. Power Electronics Circuits: Class T, fast acting.
6. Other Branch Circuits: Class RK1, time delay.

7. Control Transformer Circuits: Class CC, fast acting.

B. Plug Fuses:

1. Motor Branch Circuits: Class S, time-delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Fusible box cover switches.
4. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, accessory, and component indicated.

B. Shop Drawings: For enclosed switches. Include plans, elevations, sections, details, and attachments to other work.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

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

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D, Schneider Electric USA.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Suitable for number, size, and conductor material.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120 V(ac).
6. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

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

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D, Schneider Electric USA.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Suitable for number, size, and conductor material.
4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120 V(ac).

2.3 FUSIBLE BOX COVER SWITCHES

A. Manufacturers:

1. Cooper Bussman, Inc.

2. Ferraz Shawmut, Inc.
3. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

B. Description: Box cover units for standard electrical boxes with fused switch protection, Type S dual-element fuse and holder, rated 1/2 horsepower, and single-pole snap switch.

2.4 ENCLOSURES

A. Enclosed Switches: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Enclosed switches will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.

1.2 DEFINITIONS

A. CPT: Control power transformer.

B. N.C.: Normally closed.

C. N.O.: Normally open.

D. OCPD: Overcurrent protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. ABB, Motion Business
2. Eaton
3. Rockwell Automation, Inc.
4. Siemens Industry, Inc., Energy Management Division
5. Square D, Schneider Electric USA.

2.2 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type or melting alloy type.
2. Surface mounting.
3. Pilot light.

C. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Configuration: Non-reversing.
2. Contactor Coils: Pressure-encapsulated type.

a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
4. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
5. Solid-State Overload Relay:

a. Switch or dial selectable for motor running overload protection.
b. Sensors in each phase.
c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

6. External overload reset push button.

7. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
8. Push Buttons, Pilot Lights, and Selector Switches: NEMA ICS 5; heavy-duty type; factory installed in controller enclosure cover unless otherwise indicated.

D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Fusible Disconnecting Means:

a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2. Nonfusible Disconnecting Means:

a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.3 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Kitchen and Wash-Down Areas: Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in each fusible-switch enclosed controller.

D. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

F. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect, Construction Manager, Engineer, and Owner before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches and overload-relay pickup and trip ranges.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures and drivers.
2. Emergency lighting units.
3. Exit signs.
4. Automatic load control relays.
5. Lighting fixture supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LED: Light-emitting diode.

D. Lumen: Measured output of lamp and luminaire, or both.

E. Luminaire: Complete lighting fixture, including ballast or driver housing if provided.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.

1. Include driver for each fixture.
2. LED Luminaires: Include total luminous flux, electrical power, luminous intensity distribution, and chromaticity report according to IESNA LM-79.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty certificates.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

1.6 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Emergency LED Power Units, and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

B. Special Warranty for LED Luminaires: Manufacturer's standard form in which manufacturer of agrees to repair or replace components that fails in materials or workmanship within specified warranty period.

1. Warranty Period for LED Luminaires: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Comply with UL 1598.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent

doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least 0.125-inch nominal unless otherwise indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 LED LUMINAIRES

A. General Description: Minimum initial lumens and maximum input wattage indicated on Drawings, CRI 80 (minimum), and color temperature 3500 K, unless otherwise indicated.

B. Chromaticity: Comply with ANSI C78.377.

C. Energy Star Ratings: Downlights and self-powered LED lamps shall be Energy Star Rated by the U.S. Department of Energy.

D. Design Lights Consortium: LED luminaires shall be listed on the Design Lights Consortium Qualified Products List.

E. Useful Lifetime: IESNA TM-21 L70 rating of at least 50,000 hours using IESNA LM-80 test methods.

F. General Requirements for Electronic Drivers:

1. Comply with UL 8750 and with ANSI C82.11.
2. Designed for type and quantity of LED lamp modules served.
3. Drivers shall be designed for full light output unless dimmer or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Power Factor: 0.90 or higher.
8. Inrush Current: No more than 6 times rated luminaire current at 16 milliseconds.

G. Drivers for Low-Temperature Environments: Electronic type rated for 0 deg F starting and operating temperature with indicated LED module types.

H. Drivers for Dimmer-Controlled Lighting Fixtures: Electronic type, UL listed Class 2 power-limited 0 to 10 V dc controller, unless indicated otherwise.

1. Dimming Range: 100 to 5 percent of rated luminaire lumens.
2. Driver Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

4. Control: Coordinate wiring from driver to control device to ensure that the driver, controller, and connecting wiring are compatible.

I. Drivers for Bi-Level Controlled Lighting Fixtures: Electronic type, UL listed Class 2 power-limited control.

1. Operating Modes: Driver circuit and leads provide for remote control of the light output of the associated luminaire between high- and low-level and off.

a. High-Level Operation: 100 percent of rated lamp lumens.
b. Low-Level Operation: 30 percent of rated lamp lumens.

2. Driver shall provide equal current to each LED module in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and LED lamp module type indicated.

2.4 EMERGENCY LED POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with driver. Comply with UL 924.

1. Emergency Connection: Operate LED modules continuously at an output of 1100 lumens. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture driver.
2. Nightlight Connection: Operate one LED module continuously.
3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.5 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.
b. Charger: Fully automatic, solid-state type with sealed transfer relay.

c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.6 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Comply with NFPA 70 for minimum fixture supports.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Section 260519 "Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior luminaires and drivers.
2. Luminaire-mounted photoelectric relays.
3. Poles and accessories.

B. Related Sections: See Section 265100 “Interior Lighting” for outdoor fixtures installed on building surfaces.

1.2 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-6-M.

B. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.

a. Wind Importance Factor: 1.0.
b. Minimum Design Life: 25 years.
c. Velocity Conversion Factors: 1.0.

1.3 ACTION SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, and finishes.

1. Include driver for each fixture.
2. LED Luminaires: Include total luminous flux, electrical power, luminous intensity distribution, and chromaticity report according to IESNA LM-79.

B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2, "National Electrical Safety Code."

C. Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty for LED Drivers: Manufacturer's standard form in which manufacturer of agrees to repair or replace components that fails in materials or workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Poles and Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish: As indicated on Drawings.

N. Factory-Applied Finish for Aluminum Poles and Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish: As indicated on Drawings.

O. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following:

a. CCT and CRI for all luminaires.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 LED LUMINAIRES

A. General Description: Minimum initial lumens and maximum input wattage indicated on Drawings, CRI 80 (minimum), and color temperature 4000 K.

B. Useful Lifetime: IESNA TM-21 L70 rating of at least 50,000 hours using IESNA LM-80 test methods.

2.5 DRIVERS FOR LED LUMINAIRES

A. General Requirements for Electronic Drivers: Electronic type rated for 0 deg F starting and operating temperature with indicated LED module types.

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of LED lamp modules served.
3. Drivers shall be designed for full light output unless dimmer or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Power Factor: 0.90 or higher.
8. Inrush Current: No more than 6 times rated luminaire current at 16 milliseconds.

2.6 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-6-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange.

2.7 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: As indicated on Drawings.
2. Mounting Provisions: Butt flange for bolted mounting on foundation.

B. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with stainless-steel or galvanized-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.

C. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

D. Finish: Same as luminaire.

2.8 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: As indicated on Drawings.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

D. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.

E. Finish: Same as luminaire.

2.9 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Fasten luminaire to indicated structural supports.

B. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches.
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
3. Trees: 15 feet from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
2. Install base covers unless otherwise indicated.
3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth.

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth.

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

A. Ground metal poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 27 Specifications and Drawings.

1.2 SUMMARY

A. Basic materials, methods and installation guidelines applicable to the work of all Division 27 documents.

B. The information included in this Section apply too and are additional requirements for all of Division 27 documents.

C. Thoroughly review entire bid documents, including all drawings and specifications prior to bidding and include all indicated work in bid.

1.3 REQUIREMENTS

A. Project Coordination

1. Commence coordination immediately upon award of contract. Coordination includes providing and extracting related information to and from other trades for review. Failure to coordinate in a timely manner shall not result in any subsequent additional reimbursement, special allowances or additional construction time being made for any facet of the project. Work fabricated or installed before properly coordinating with all other trades shall be done at the Contractor's own risk.
2. Work in harmony with all building trades, so as not to cause any delays. Sequence, coordinate, and integrate installations of communications materials and equipment with all other applicable trades for efficient flow of the Work. In addition, contact and coordinate/facilitate work of local communications service providers for incoming communications services. Execute connections with local services providers complete as indicated.
3. The drawings indicate the approximate location and arrangement of required work. The drawings shall be followed as closely as possible in coordination and in execution of the work.
4. Participate in coordination efforts and in preparation of coordination drawings prior to fabrication or installation of any equipment, materials, etc. Coordinate actual clearances of all installed equipment.
5. Conflicts in equipment and materials shall be corrected prior to installation. Should there be a conflict with the drawings of other trades, work with the trades to correct the conflict while coordinating the project. If the conflict cannot be resolved, refer the matter to the Owner's

representative for a final decision as to method or material. Refer to drawings of all other trades for details, dimensions and locations of other work and route their work so as not to conflict with any other branch. Any work installed or equipment placed in position by this contractor creating a conflict shall be readjusted to the satisfaction of the Owner's representative at the expense of this contractor.

6. All products furnished of a given type shall be by a single manufacturer; shall bear the same brand name; shall be of the same finish color and texture; and shall be from the same product model series, unless otherwise noted.
7. Plans are diagrammatic indicating design intent and indicating required size, points of termination and, in some cases, suggested routes of raceways, etc. However, it is not intended those drawings indicate fully coordinated conduit routing, all necessary offsets, etc. Provide all cable assemblies, etc. as straight as possible and symmetrical (perpendicular to or parallel with) with architectural items and in a consistent elevation. Do not provide work installed diagonal to building members.

B. Product Data

1. Provide complete product master material list per individual specification section. Each product item must reference the specific paragraph for which the product is being submitted. See following example of product master material list:

Specification Paragraph	Manufacturer	Part Number	Description
2.2	General	6AP4P24-PUR-R-GCC-AP	Category 6A Horizontal Cable
2.3.B	Panduit	CFPE4WHY	Mini-com Faceplate
2.3.C	Panduit	CPPL48WBLY	Mini-com Patch Panel

2. Provide the following information for each product:

   a. The manufacturer’s name (Brand) and full model number.
   b. Product Information Sheets “Datasheets”: Include catalog information, sizing, and technical data on each item to be used on the Project.
   c. Each product datasheet must reference the specific paragraph for which the product is being submitted. Each product must be listed in the exact same order as it appears in the Section for which the products are being submitted.
   d. Datasheets shall each include a clearly identifiable label applied in upper corner of each sheet that clearly references the specification section and drawing (as applicable)

to which it applies. Labels shall be consistently affixed in the same location on all sheets unless the labels will obstruct pertinent technical information.

3. All datasheets shall be original manufacture datasheets, first generation copies of manufacturer's electronic datasheet (i.e. PDF file).
4. Where datasheets depict multiple products, versions or options, the Contractor shall highlight (indicate with an arrow) all applicable model(s), version(s) and option(s) applying to the specific product the Contactor will be providing. Exact catalog number must be indicated. The submitted items must be from "approved materials" as specified in each Specification Section.
5. Do not combine with submittals from any other Division or specification section.
6. Provide detailed schematic connectivity drawings as requested.

C. Operation And Maintenance Manuals

1. Prepare Operations and Maintenance Manuals in accordance with Division 1 Section "Maintenance and Operation." In addition to the requirements specified in Division 1, provide additional information as detailed in each Section and include the following information:

D. Building Codes:

1. National Electrical Code (NFPA 70)
2. Life Safety Code (NFPA 101)
3. National Electric Safety Code
4. Uniform Building Code (Or adopted State Code)
5. Federal Communications Commission (FCC) Part 68
6. State specific agencies:

    a. Administrative Building Council
    b. State Board of Health
    c. State Fire Marshal

7. Local Codes (City, County, etc.)
8. Local Utility Company requirements

E. Standards

1. ANSI/TIA 568 Commercial Building Telecommunications Cabling Standard.
2. ANSI/TIA 569 Commercial Building Standard for Telecommunications Pathways and spaces.
3. ANSI/TIA 606 The Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings.
4. ANSI/TIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications.
5. ANSI/TIA 590 -Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant.
6. ANSI/BICSI 007-2020, Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
7. ANSI/TIA 758 Standard -Outside Plant Cabling Systems.

8. American Association of State Highway and Transportation Officials (AASHTO)
9. BICSI Telecommunications Distribution Methods Manual.
10. BICSI Outside Plant Design Reference Manual.

F. Permits

1. Contractor shall obtain and pay for all permits or certificates of inspection and approval required for his branch of the work.
2. Permits shall be posted in a prominent place at the building site properly protected from weather and physical damage.

G. Definitions

1. Wherever the word “Install” appears on the drawings or in these Division 27 specifications it shall mean to supply all labor, tools and incidental materials necessary to handle, store, mount, terminate, program, configure and adjust product as necessary to fulfill project requirements.
2. Wherever the word "Provide" appears on plan drawings or in Division 27 specifications, it shall be interpreted to mean that the Contractor shall "Furnish and Install", including all necessary accessories, miscellaneous materials and labor necessary to render the respective system fully operational.
3. Wherever the word "Work" appears in Division 27 specifications or on communication technology drawings, it shall be interpreted to mean any and all labor, materials, accessories, services, etc. necessary to fulfill project requirements.
4. Wherever the word “Furnish” appears on the drawings or in these Division 27 specifications it shall mean to supply the specified labor or specified product, including all associated shipping, storage and warranty expenses.
5. Wherever the words “Site”, “Project Site”, or “Premises” appears in Division 27 specifications or its related drawings, it shall be interpreted to mean all real estate, buildings and structures where work will be performed and where products will be installed and reside.
6. Wherever the phrase “Standard of Quality” appears in Division 27 specifications or its related drawings, the Contractor shall interpret this to mean that the listed Manufacturer and Catalog number for each item has the physical, functional, and operational attributes to provide the designed functionality.

H. Quality Assurance

1. Contractor shall have a minimum five (5) years’ experience in the installation of Communication Technology system(s) of similar size, type, scope and contract value.
2. The Prime Contractor or his subcontractor responsible for this Section shall have a Registered Communications Distribution Designer (RCDD) on staff that will be ultimately responsible for this Project. The RCDD must have sufficient experience in this type project as to be able to lend adequate technical support to the field forces during installation, the warranty period, and any extended warranty periods or maintenance contracts. If in the opinion of the Owner, the RCDD does not possess adequate qualifications to support the Project, the Owner reserves the right to require the Contractor to assign an RCDD who, in the Owner’s opinion, possesses the necessary skills and experience required of this Project.
3. The lead technician(s) on the Project shall carry a current BICSI Technician Certificate or have five years of experience in projects of similar scope.

4. The lead technician(s) on the Project shall have a thorough understanding of the standards and codes referenced in this document.
5. Contractor shall be a factory trained and certified installer for all connectivity products.

    a. This minimum requirement shall apply to each Division 27 section independently. If Contractor is incapable of meeting the percent of product value requirement for each section, Contractor shall use a Subcontractor that can meet the percent of product value requirement, in whole, for all products and work of that section for which This Contractor is not qualified.
    b. The specific Contractor or Subcontractor meeting the requirements for a specific section shall be responsible for the supply of the products, supplemental engineering services and submittals as well as performing all technical labor associated with the installation, training and warranty servicing of work of that section.

6. Contractor shall have substantial business operations located within a 100-mile radius of the project site with a full-time employee staff actively engaged in the supply, installation and service of systems and equipment of the type and scope herein specified.
7. Contractor shall have full-time employee service staff based within a 100-mile radius of the project site.
8. Contractor shall provide any additional information requested by the Owner as determined appropriate by the Owner to validate a Contractor's (or its Subcontractor's) ability to perform and warranty the specified work in the quality, manner and time frame required.
9. Superintendent/Project Manager

    a. This Contractor shall furnish the services of an experienced superintendent/Project Manager who shall be constantly in charge of the work, together with the qualified Foremen and specialists as required to properly install, connect, adjust, start, operate and test the work involved.
    b. The superintendent's/Project Manager's qualifications shall be subject to the review and acceptance by the Owner/Owner. Unless the Owner/Owner grants prior special permission, the same communication Superintendent/Project Manager shall be utilized throughout the duration of the project and be responsible for the complete scope of the Contract.

I. Product Delivery Requirements

1. The Contractor shall not procure, deliver or install any product until after the contractor's submittal has been reviewed by the Owner and the submittal has been returned to the Contractor's marked "Reviewed As Submitted" or "Reviewed as Noted". Advance procurement, delivery or installation of product prior to the return of submittal is entirely at the Contractor's own risk. Contractor should schedule its work and procurement accordingly.
2. Prior to procurement of any equipment or materials, Contractor shall review the model numbers, compatibility and interoperability of all products.
3. Prior to procurement, Contractor shall, through coordination with other trades and through field measurements and project site inspections, verify that products to be supplied can be physically installed as planned.
4. No claim for additional payment will be considered for the return of any equipment determined incompatible, or procured without adhering to the aforementioned conditions, including claim for reimbursement of manufacturer's "restock" fees.

5. Contractor shall factor all of these conditions into its bid and plan its scheduling and resource needs accordingly to ensure that all work shall be performed according to the Owner's schedule and requirements of this contract.

J. Product Storage and Handling Requirements

1. The Contractor is responsible for receiving, handling, storing, and protecting all materials used on this Project until Substantial Completion.
2. Pack components in factory-fabricated protective containers.
3. Units shall be delivered in sections of such size as will pass through available openings.
4. Until ready for installation, store products in original factory containers.
5. Products shall be stored in a clean, dry space and as additionally recommended by the product manufacturer.
6. Keep products out of the weather and away from construction traffic and debris, including drywall finish dust.
7. Do not exceed structural capacity of the floor or platform on which the products are stored.
8. Until final acceptance of the system, protect all supplied products from damage resulting from moisture, fumes, dirt, dust and debris or any other source of potential damage.
9. Handle all products with care before, during and after installation so as to prevent damage.
10. Replace any products damaged prior to final acceptance with new replacement products.
11. Replacement shall be at Contractor's expense.
12. Contractor is responsible for the safety and good condition of the materials and equipment installed until final acceptance by the Owner.
13. Save original product shipping containers and related packaging materials for major products until final acceptance.
14. Prior to disposal, check with Owner to determine if the Owner wishes any of the packaging materials.

K. Examination and Preparation

1. Contractor shall visit the Site to familiarize himself with the local conditions under which the work is to be performed and correlate his observations with the requirements of the Contract Documents. No allowance shall be made for claims for concealed conditions which the Contractor, in exercise or reasonable diligence in observations of the Site and review of the local conditions under which the work is to be performed, learned or should have learned of, unless otherwise specifically agreed by Owner and Owner in writing.
2. Before ordering any materials or doing any work, the Contractor shall verify all measurements and be responsible for correctness of same. No extra charge or compensation will be allowed for duplicate work or material required because of an unverified difference between an actual dimension and the measurement or size indicated in the drawings or specifications. Any discrepancies found shall be submitted in writing to the Project Manager and Owner for consideration before proceeding with the work.
3. This Contractor must verify all dimensions locating the work and its relation to existing work, all existing conditions and their relation to the work and all manmade obstructions and conditions, etc. affecting the completion and proper execution of the work as indicated in the Contract Documents.

L. Installation

1. Provide all required labor, materials, equipment and Contractor's services necessary for complete installation of systems required to comply with the requirements of authorities having jurisdiction, as indicated on Drawings, and as specified.
2. Work shall be functional and complete in every detail, including any and all items required to complete the system, whether or not these items have been enumerated or shown on the Drawings.
3. Special attention shall be given to access to working and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.
4. Each Contractor shall be fully knowledgeable of the details of all Work to be performed by other trades and take necessary steps to integrate and coordinate his Work with other trades.
5. Wherever tables or schedules show quantities of materials, they shall not be used as a final count. These figures serve only as a guide for the Contractor. Each Contractor shall be responsible for furnishing all materials on the Drawings or as specified.
6. The Consultant and Owner's Representative have full power to condemn or reject any Work, materials or equipment not in accordance with these Specifications and Construction Drawings or the manufacturer's specifications or drawings approved by the Owner or Consultant.
7. Work or equipment that is rejected shall be removed and replaced to the satisfaction of the Owner at the Contractor's expense. Work or equipment that is rejected shall be so stated in writing by the Owner or Consultant.
8. Such decisions that the Owner or Consultant may make with respect to questions concerning the quality, fitness of materials, equipment, and workmanship shall be binding upon the parties thereto.
9. All Work shall fully comply with these specifications and related Drawings and all manufacturers recommended installation practices.
10. All Work shall be performed with the best practices of the trade for performance, functionality, safety, endurance, and aesthetics.
11. Coordinate ordering and installation of all equipment with long lead times or having a major impact on work by other trades so as not to delay the job or impact the schedule.
12. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible, as appropriate to the application.
13. Set all equipment to accurate line and grade, level all equipment and align all equipment components.
14. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from premises when no longer required.
15. No equipment shall be hidden or covered up prior to inspection by the Owner's representative. All work that is determined to be unsatisfactory shall be corrected immediately.
16. All work shall be installed level and plumb, parallel and perpendicular to other building systems and components.
17. Install all equipment and materials in strict accordance with manufacturer's written instructions. Bring any conflicts between the manufacturer's written instructions and these specifications to the attention of the Designer for recommendations.
18. Upon completion of installation of equipment and communication circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with re-testing.

M. Cutting and Patching

1. Where demolition of existing surfaces are required by the Work, the same shall be restored to at least as good a condition as they were before.
2. Contractor shall be responsible for painting, patching, repairing and replacing any building surface, furnishing, wall/floor/ceiling covering that is damaged or penetrated in the process of performing work on the project site.
3. Additional work required to repair work performed under this Contract shall be at the expense of This Contractor.
4. The Division 27 contractor shall do all cutting as required for the admission of Division 27 work. Unless directed otherwise in field, provide all related patching and painting to match surrounding methods, materials and colors. Any damage done by this contractor to the building during the progress of this contractor's work shall be made good at this contractor's expense.

N. Site Maintenance

1. During the progress of the work, the Contractor shall clean and leave the premises and all portions of the building in a clean and safe condition. This cleaning shall occur on a daily basis.

O. Final Cleaning

1. Clean all parts of the apparatus and equipment. Exposed parts, which are to be painted, shall be cleaned of cement, plaster and other materials and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all corners and cracks scraped out.

P. Closeout Requirements

1. Upon the Designer's receipt of and approval of the Contractor's pre-test submittal, the Contractor shall contract the Designer to schedule acceptance testing. Contractor shall allow not less than 10-business days of advance notice to the Owner.
2. In the presence of the Owner, the Contractor shall demonstrate the presence of all specified products, cabling and installation methods. The Contractor shall demonstrate the operation of the system (and any requested sub-component thereof) and shall be prepared to make any electronic, physical or software related adjustments to the system or any of its sub-components to the satisfaction of the Owner, as required to achieve full compliance with the specifications.
3. The contactor shall have available at the project site all test equipment, cables, tools and personnel necessary to demonstrate full compliance with these specifications as determined necessary by the designer.
4. During the acceptance testing the Contractor shall have a clean and fresh copy of the contractor's most up-to-date as-built record documentation, printed to scale.
5. This Contractor shall provide all required labor services required to completely verify and test the systems in the presence of the Owner.
6. Verify that each system, as a whole system, meets these Specifications and complies with all applicable standards.
7. Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense.

Q. Warranties

1. Specified materials and workmanship provided shall be fully guaranteed by the Contractor for one year from the transfer of title via notice of substantial completion against any defects in materials or workmanship.
2. Extended (additional) warranty(ies) may be required and will be identified in the individual Specification Section and will be considered additive to this base Contractor Warranty.
3. Requirements for Manufacturer's Warranties, required by a Specification Section, shall run concurrent to this base Warranty by the Contractor but may exceed the Contractor's Warranty Period.
4. Manufacturer's Warranties shall also begin upon Substantial Completion.
5. The Warranty shall begin upon Substantial Completion.
6. This warranty shall in no manner cover equipment that has been damaged or rendered unserviceable due to negligence, misuse, acts of vandalism, or tampering by the Owner or anyone other than employees or agents of the Contractor.
7. The Contractor's obligation under its warranty is limited to the cost of repair of the warranted item or replacement thereof, at the Contractor's option.
8. Insurance covering said equipment from damage or loss is to be borne by the Contractor until full acceptance of equipment and services.
9. Individual specification sections may have additional warranty requirements for the work in that section. The warranty above will cover all materials and work where not covered by an extended warranty listed in the individual specification section.
10. Specified materials and workmanship provided shall be fully guaranteed by the Contractor against any defects in materials or workmanship.
11. Contractor shall provide a full "System Warranty" which shall cover all materials, labor and related product shipping expenses for a period of five years from the date of Owner acceptance.
12. Supplied products with manufacturer's warranties of less than the System Warranty term shall be extended by the Contractor for the full specified term.
13. During this period the Contractor will remedy (at no cost to the Owner) any problem with the system, or any of its related components that is the result of defective materials, settings, workmanship, or loss or programming.
14. Any defective items or work shall be removed and replaced at the Contractor's expense to the satisfaction of the Owner's representative and the Owner.
15. The period of the Contractor warranty(ies) for any items herein are not exclusive remedies, and the Owner has recourse to any warranties of additional Scope given by the Contractor to the Owner and all other remedies available by law or in equity.
16. Additional Warranty requirements may be added by an individual Specification Section.
17. Scope of these extended (additional) warranty(ies) will be identified in the individual Specification Section and will be considered additive to this base Contractor Warranty.
18. Requirements for Manufacturer's Warranties, required by a Specification Section, shall run concurrent to this base Contractor Warranty by the Contractor.
19. Manufacturer's Warranties shall also begin on Substantial Completion.

R. Demonstration and Training

1. Each Division 27 section may specify special Training requirements.
2. Training requirements will be for a quantity of hours, allow for multiple trips.

3. If no special requirements are specified in the individual section, provide training and trips for basic overview, operation and maintenance information per system.
4. Train Owner's maintenance personnel on the procedures and schedules involved in operating, general troubleshooting, and preventative maintenance of the system.
5. Contractor shall require all attendees to sign-in for each training session. The sign-in form shall summarize the training to be conducted, specification section and subsection being trained on, as well as the starting time and duration of training. Following training, a representative of the Owner shall sign the form, acknowledging the same. Contractor shall retain the original copy of these forms and turn over a photocopy of the form to the Owner's representative as evidence of training. Training conducted without this official record of training shall not be considered as part of the Contractor's training obligation.
6. Schedule training with the Owner's representative, at least 14 days in advance.

PART 2 - PRODUCTS

2.1 ASSIGNMENT OF MISCELLANEOUS WORK

A. Excavating and backfilling for telecommunications work shall be by telecommunications contractor.

1. Properly support banks of excavation with safety sheet pile. Install necessary guards. Provide adequate pumping equipment and keep excavation free of water.
2. Excavate pipe trenches to proper depth. Where rock is encountered, excavate to 6 inches below pipe and refill to 6 inches above pipe with compacted granular fill. Granular fill shall consist of dune sand, gravel or other suitable material containing not more than 10 percent by weight passing #200 sieve and 100 percent passing 1-inch sieve.
3. Excavation for utilities shall not be backfilled until all required tests are performed and approved by Engineer and the utility company.
4. Whenever underground feeders are run below footings and grade beams, contractor shall backfill the void with poured, steel-reinforced concrete to elevation of bottom of footing or grade beam.
5. Backfill within building lines shall be made with granular fill or compacted backfill material laid in 6-inch layers and tamped to specified compaction after each layer.
6. Backfill under paved area shall be made with granular fill compacted backfill material laid in 12-inch layers and tamped to compaction after each layer.
7. Backfill under open yards or fields shall be made with non-compacted backfill laid in layers not to exceed 24 inches deep. Sand trenches may be allowed to settle naturally and shall be refilled back to grade as required during first year after final acceptance.
8. Contractor shall refill, regrade and refinish any area that becomes unsatisfactory due to settlement within one year after final acceptance.
9. Contractor shall verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to any trenching, excavation or underground installation. In event existing conditions are such as to prevent installation in accordance with Drawings, contractor shall immediately notify Engineer.
10. Provide appropriate plastic marker tape buried directly above underground electric and communication lines continuously along length of lines. Marker tape shall be located 12 inches below finished grade, but no closer than 12 inches above underground lines. Tape shall be a minimum of 6 inches wide.

11. Refer to Division 31 Section “Earth Moving,” for additional requirements. In event of conflict between this section and Division 31 Section “Earth Moving,” Division 31 Section “Earth Moving” shall apply, unless otherwise indicated by Engineer.

B. Sleeves and small openings (not framed) for electrical equipment shall be furnished and set by contractor.

1. Where electrical conduits pass through walls, roofs, ceilings, or floors, contractor shall have sleeves set for them when floors, walls, ceilings or roofs are constructed. If any holes are cut in finished work where sleeves have been omitted, cutting shall be done with a concrete coring machine or other approved means and only with consent of Engineer. All such holes are to be carefully cut and shall not be larger than necessary. These holes are to be entirely covered by escutcheon plates when work is completed. Sleeves shall be made of pipe or rolled sheet steel no lighter than No. 18 gauge.
2. Where conduits pass through sleeves in exterior walls above grade, annular space shall be caulked with oakum and filled inside and out with non-hardening, waterproof sealant finished off flush with both faces of wall.
3. Provide penetration seals for all conduits penetrating the building wall below grade.

    a. Description: The pipe to wall penetration closures shall be "Link-Seal" or equal, as manufactured by PSI/Thunderline Corporation – Houston, TX. Seals shall be modular type, consisting of synthetic rubber shaped to continuously fill the annular space between the pipe and wall opening. After the seal assembly is positioned in the sleeve, the rubber sealing elements shall provide an absolutely water-right seal between the pipe and wall opening. The seal shall be constructed as to provide electrical insulation between the pipe and wall, thus reducing changes of cathodic reaction between these two members.
    b. Wall Opening: Provide “Century-Line” sleeves or equal as manufactured by PSI/Thunderline Corporation – Houston, TX. Contractor shall determine the required inside diameter of each individual wall opening of sleeve before ordering, fabricating or installing. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and Link-Seal to assure a water-tight joint. Sizing (correct Link-Seal model and number of links per seal) may be obtained through manufacturer's catalog. If pipe O.D is non-standard due to coating, insulation, etc. consult Thunderline's factory for engineering assistance and recommendation before proceeding with wall opening detail.
    c. Holes through Structural members: Holes required for conduit of size 5-inches and smaller shall be cut in field at expense of contractor. Obtain structural engineer’s approval in writing prior to any cutting.
    d. Pitch Pockets: Required for conduit penetrating roof. Seal sleeves and provide flashing.
    e. Dust Protection: Provide temporary partitions or barriers required to protect existing building or facility. Coordinate necessity and location of such protection with Owner.
    f. Painting of telecommunications cabling and components is not permitted. Notify painting contractor that painting of telecommunications cabling and components is not permitted. Protect cabling as necessary to avoid painting.

2.2 MATERIALS AND EQUIPMENT

A. Electrical equipment shall be new, listed by UL and shall conform to NEMA and ICEA standards.

B. Materials used for like service shall be by same manufacturer.

C. All materials and equipment, including any hangers, supports, fastenings or accessory fittings, shall have corrosion protection suitable for atmosphere in which they are installed, whether located indoors or out. Care shall be taken during installation to assure integrity of corrosion protection.

D. All screws, bolts, nuts, clamps, fittings or other fastening devices shall be made up tight. All bolts, screws, nuts and other threaded devices shall have standard threads and heads so they may be installed and replaced when necessary without special tools.

2.3 PRODUCT AND MATERIAL APPROVAL

A. A Specification followed by one or more manufacturers is limited to those manufacturers. Names of other manufacturers may be submitted for approval to Engineer a minimum of ten (10) days prior to receiving bids. Approval will be issued by Addendum if granted.

B. A Specification followed by one or more manufacturers and "or approved equal" is open to all equal products or materials; however, Contractor shall supply one of listed manufacturers at no additional cost if Engineer finds substituted product unsatisfactory.

2.4 CAULKING AND FIRESTOPPING

A. In addition to the requirements in Division 07 Section “Penetration Firestopping,” comply with this Article.

B. All raceway and sleeve penetrations of fire barriers shall be sealed to achieve fire resistance equivalent to fire separation.

1. Maintain fire rating per ASTM E-814 and UL 1479.
2. This assembly must also maintain a watertight seal between floor or wall and pipe.

C. For other penetrations through non-rated walls, partitions, floors and ceilings, caulk the space between raceways and raceway sleeves with non-staining, waterproof gun grade compound. Apply caulking compound by the gun method using nozzles of a proper size to fit the width of joint. Prepare the joint for caulking by packing it tightly with a resilient foam or rope yarn.

D. Products: Subject to compliance with requirements, provide one of the following:

1. Maintain fire rating per ASTM E-814 and UL 1479.
2. Penetration sealant:

a. 3M Brand "Moldable Putty Pads": and "Moldable Putty Stix"
b. 3M Brand "Fire Barrier" Caulk, Putty or Penetrating Sealing Systems

c. Dow Corning "Fire Stop Foam: and "Fire Stop Sealant" systems
d. Insta-Foam Products, Inc. "Insta-Fire Seal Silicone RTV Foam"
e. Standard Oil Engineering Materials Company, "Frye Putty"
f. Chase technology "Chase Foam #CTC PR-855"

3. Intumescent Sealant for use at openings and sleeves involving flexible cable.

   a. 3M Brand "Fire Barrier" caulk or putty, FS-195 Wrap Strip and CS-195 Composite Sheet.
   b. Dow Corning "Fire Stop Intumescent Wrap Strip"
   c. Fox Couplings, Inc. "The Fox Cast-in-Place Coupling"

4. Performance Characteristic: Firestopping materials shall conform to both Flame (F) and Temperature (T) ratings as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test.

   a. F Rating shall be a minimum of one hour but not less than the fire resistance rating of the assembly being penetrated.
   b. Conduct the fire test with a minimum positive pressure differential of 0.01 inches of water column.

5. Quality Assurance: Installer qualifications – a firm specializing in firestopping installation with not less than two years of experience or trained and approved by firestopping manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION OF COMMUNICATIONS SYSTEMS

A. General

1. All work installed in finished areas shall be concealed.
2. Install systems, materials, and equipment to conform with approved documents.
3. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
4. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
5. Verify all dimensions by field measurements. Take measurements and be responsible for exact size and locations of all openings required for the installation of work. Proposed dimensions are reasonably accurate and should govern in setting out work. Where detailed method of installation is not indicated or where variations exist between described work and approved practice, direction of the Owner's representative on job shall be followed.
6. Workmanship throughout shall conform to the standards of best practice. Marks, dents or finish scratches will not be permitted on any exposed materials, fixtures or fittings. Inside of panels and equipment boxes shall be left clean.
7. Use caution not to exceed the allowed bend radius for respective cables and not to compromise the integrity of the cables during installation by pulling cable management

devices too tightly, damaging cables, etc. Raceway/Cabling bending radii shall be minimum as directed by cable manufacturer. Use pulling compound or lubricant, where necessary; compound must not deteriorate conductor or insulation.

B. Cable

1. Provide color-coded jackets to identify different systems.
2. Within the telecom room:

    a. Neatly comb out multiple cable bundled runs to remove tangling and crossing of cables within the bundles. Neatly dress all cable work and provide vertical and horizontal cable management (or other approved method) for properly dressing all work at racks, control panels, backboards etc.
    b. Provide spacing between cable bundles to help dissipate heat. Do not cinch cables into tight bundles. Bundle cables shall not exceed a quantity of 24 cables per bundle.

3. Nylon cable ties are not permitted. Bundle cables with “Velcro” style cable straps with a minimum of 1-inch width.
4. All cables shall be supported every 5 feet (or less) and within 12" of device boxes, outlets, racks/cabinets and cable tray.
5. Use separate J-Hook cable support systems for cables belonging to different systems and for cables carrying different operating levels.
6. Loosely secure cables at each J-Hook.
7. Cables shall not be directly or indirectly supported by a suspended ceiling or any other surface, support, material or structure not permissible for this use by all applicable codes and standards.
8. Cables carrying signals of different nominal operating level shall be kept separated to reduce the risk of undesirable cross-talk interference between cables.
9. Keep length of parallel runs to a minimum. Cross cables of different nominal levels at 90 degrees.
10. Provide additional separation as necessary to prevent and remedy any crosstalk.
11. Contractor shall take all precautions necessary to keep low-voltage cable away from sources of EMI and RF interference. Where close proximity is absolutely necessary to satisfactory appearance, performance or installation of the Work, provide all necessary shielding necessary to ensure that ingress interference is minimal and has no negative impact of the Work.
12. Provide a minimum of 12 inches cable slack where terminating at a device outlet to facilitate installation and servicing of devices. Longer working lengths shall be provided as appropriate to the application.
13. All termination types shall correctly match the cable and device termination point. Connectors of the appropriate type, size, color and rating shall be used to match with the mating equipment.
14. Tools as recommended by each specific connector manufacturer shall be used in attachment of all connectors.
15. When spade connectors are the required to be used for audio circuits operating at <= +8dBv nominal, solder type spade connectors only shall be permitted.
16. No more than two spade connectors shall be permitted under a single terminal. Fewer should be used when recommended by the specific manufacturer’s equipment or connector.
17. Wire Nuts

a. Wire nuts shall not be used in any audio circuit, except when necessary in the following:

   1) 25 Voltage Constant-Voltage loudspeaker circuits.
   2) 70 Voltage Constant-Voltage loudspeaker circuits.

b. Wire nuts shall not be used in any data or voice communications or remote-control circuit.
c. Wire nuts shall not be used in any circuit which radiates RF energy.
d. Contractor must advise and gain prior approval of the Owner for any circuit which the Contractor desires to use wirenuts as the means of termination.

18. Drain Wires, Non-insulated Ground Wires and Shields

a. Drain or non-insulated ground conductors shall be insulated with appropriately sized heat-shrinkable insulated sleeving immediately upon exit from the jacket of the cable. Contractor shall use GREEN colored sleeving unless otherwise necessary to resolve specific color-coding conflicts on a given cable. This methodology shall apply to ALL methods of termination, including inline connectors, device plates, direct equipment terminations etc… Sleeving shall be applied to twisted and braided shields once the internal conductors have been combed out or otherwise removed from the center of the shield.
b. Wherever a cable contains a non-insulated conductor within a jacketed cable, the conductors, as they exit the manufacturer's jacket, shall have a piece of heat shrinkable sleeving applied equally over the jacket and the exposed insulated conductors. The length of this sleeving shall be 1" for all cable diameters of .250" or less. For cables diameters larger than .250" the length of the sleeving shall be approximately equal to 4 times the diameter of the cable jacket. Note: This added sleeving is recommended but not mandatory when cable termination occurs fully within the confines of a fully insulated and strain relieved connector. Black shall be used unless otherwise necessary for specific cosmetic or cable identification purposes.
c. A heat-gun of the appropriate temperature, size, type and rating for shrinking the tubing shall be used as recommended by the manufacturer of the sleeving used. Open flame (i.e. matches, cigarette lighters, torches) and direct metal conduction (i.e. soldering iron) methods to shrink the sleeving shall not be permitted. Sleeving which is burnt or otherwise marred shall be removed and replaced.
d. There shall not be any non-insulated exposed conductors within a device backbox, junction box, or equipment rack/cabinet.

19. Unused Conductors

a. Unused conductors shall not be "clipped" or removed from any jacketed cable. Conductors which are not required or used at the end of a jacketed cable shall be kept intact. Conductors shall be fully insulated from one and other to prevent shorts which could occur at either end of the cable. Conductor ends shall also be insulated to prevent shorts to other conductive materials which could come in contact with the conductor.
b. Unused conductors shall be kept the same length as the longest conductor of the cable being used.

c. Attention shall be paid to the proper preparation of all cables and all conductors of these cables. There shall not be nicks to cable jackets, conductor insulation, or the conductors themselves.
d. Special attention should be paid to nicked conductors. Should a conductor be nicked during preparation or termination the cable shall be reworked/replaced to remove the nick.
e. Any voice, data, or coaxial cable that is cut, disconnected, or not terminated at both ends shall be completely removed end to end. Any labels at either end shall be erased. Record drawings shall reflect the removal of these cables.

3.2 ATTACHING TO BUILDING CONSTRUCTION

A. Attach supports to structural members (beams, joists, etc.) rather than to floor or roof slabs. Do not attach to ceiling support wires.

B. Where equipment and raceway are suspended from existing concrete or masonry construction, use expansion shields to attach supports to construction. Expansion shield bolt diameter shall be same size as support rod diameter, hereinafter specified. Expansion shields shall be Star Double, Star Gloxin, Star Loxin or approved equal.

C. Where existing masonry is not suitable to receive and hold expansion shield or where other means of attachment is advantageous, submit alternate method for approval by Engineer.

D. Equipment to be installed in groups shall not be mounted directly to masonry or concrete walls. Mount 1- by 1-inch structural channel such as Unistrut, to wall and secure equipment to these channels.

E. Where raceways are suspended from structural steel building framing or supporting members, provide beam clamps for attaching piping device to building member.

F. Obtain approval from Owner and structural engineer before cutting or welding to structural members, or before hanging heavy equipment.

3.3 ESCUTCHEONS

A. Provide chrome plated escutcheons on material, leaving and entering walls, floors, ceilings, etc.

3.4 EQUIPMENT INSTALLATION

A. All equipment must be installed such that maintenance and service may be properly accomplished. If necessary, the Owner, at their option, may require the contractor to demonstrate the service on any piece of equipment to determine sufficient service space exists. If the service space is not adequate, the equipment shall be relocated at no additional cost to the Owner such that sufficient service space is achieved.

3.5 OCCUPATIONAL SAFETY & HEALTH STANDARDS

A. All work shall comply with current requirements of U.S. Department of Labor-Occupational Safety & Health Administration, entitled Occupational Safety and Health Standards; National Consensus Standards and Established Federal Standards.

3.6 DEMOLITION

A. In addition to the requirements in Division 02 Section "Selective Demolition," comply with this Article.

1. Scope of Work: Provide demolition required for removal of systems and equipment made obsolete by this Project and as determined by the Architect/Engineer.
2. Work Included:

    a. Non-destructive removal of systems, materials, and equipment for reuse or salvage as shown on Drawings or requested by Owner.
    b. Removal of all debris from site and legal disposal of same.
    c. Removal of all abandoned or obsolete exposed materials and equipment for a clean and finished installation.
    d. Removal of all abandoned or obsolete raceways, wiring, cabling, or electrical devices of any kind.

B. Conditions

1. Coordination: Adjacent areas need to remain in operation and services to these areas need to be maintained. A schedule will be worked out prior to beginning work and as many criteria for operation as possible will be explained. Contractor cooperation shall be expected in all conditions.
2. Phasing:

    a. Prior to commencing demolition in any area of the work, notify the Owner and Architect/Engineer five (5) working days in advance to insure that no adjacent occupied areas will be disrupted.
    b. Demolition phasing must be approved by Architect/Engineer prior to commencement of operations.
    c. Removal of debris and construction traffic will be limited to specified areas. Confirm all operations with Architect/Engineer prior to commencement of work.

3. Adjacent Materials:

    a. During the execution of the work, primary consideration shall be given to protecting from damaging the structure, furnishings, finishes, and the like which are not specifically indicated to be removed and disposed.
    b. Provide and maintain temporary partitions or dust barriers adequate to keep dirt, dust, noise and other particles from being transferred to adjacent areas.
    c. Existing items or surfaces to remain which are damaged as a result of this work shall be refinished, repaired, or replaced to the satisfaction of the Architect/Engineer and Owner at no additional cost.

C. Materials

1. Patching: Materials used for patching shall be in conformance with the applicable sections of the Project Manual. Where materials are not specifically described but required for proper completion of the work, they shall be as selected by the Contractor subject to approval of the Architect/Engineer. Materials used and workmanship shall match surrounding areas as much as possible, unless otherwise directed.

D. Demolition

1. Site Inspection

   a. The Contract Documents do not propose to show all systems, materials, or equipment existing on the project that will require demolition.
   b. Before commencing the work of this Section, verify with the Architect/Engineer and Owner all systems, materials, and equipment to be removed and those to be preserved.

2. Scheduling

   a. Schedule all work in a careful manner with all necessary considerations for public and adjacent areas.
   b. Avoid interference with the use of adjacent areas and passage to and from these areas.

3. Abandoned Materials and Equipment: Items so indicated on Contract Documents to be removed and not indicated or specified to be saved or retained, shall be demolished, removed, demounted, or disconnected in the best possible manner to ensure that no damage will result to other adjacent items or surfaces to remain.
4. Salvage

   a. During removal of items so indicated, caution shall be used to eliminate damage to any equipment having salvage value.
   b. All reusable salvaged material shall remain the property of the Owner and be retained for his inspection. Only items so inspected and rejected by the Owner shall be disposed by the Contractor. All other such items shall be turned over and deposited as directed by the Owner.

5. Disposal and Clean Up

   a. Areas in which demolition and salvage work is being done shall be cleaned daily.
   b. Dirt, dust, debris, unsalvageable and reusable items, and the like shall be totally removed from the project site daily. Under no circumstances shall such refuse be allowed to collect for longer periods.
   c. Refuse shall not be allowed to block, or otherwise impair, circulation in corridors, stairs, sidewalks, or other traffic areas.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Supplementary to Division 1, Refer to Division 27 Section(s) for additive information where applicable.

1.2 SUMMARY

A. Section Includes:

1. Grounding and Bonding requirements for Communication Systems

a. Copper Conductors
b. Busbars
c. Termination Devices
d. Hardware
e. Labels

B. Related Sections

1. All Division 27 Sections

C. Related Drawings

1. All Division 27 Drawings

1.3 REFERENCES:

A. See “Common Work Results for Communications”.

1.4 SYSTEM DESCRIPTION / DESCRIPTION OF WORK

A. Provide, and test a complete Telecommunications Bonding and Grounding (Earthing) system as indicated.

1. Communications infrastructure components will achieve a common ground with the building’s grounding electrode system.
2. Provide system complete, bonding all components as indicated in referenced standards.

B. Coordinate thoroughly with Division 26 Electrical Contractor.

PART 2 - PRODUCTS

2.1 PRODUCT STANDARDS

A. General

1. This section is designed to provide the Contractor with a minimum standard of quality and functionality for the products used for telecommunications infrastructure.
2. This standard will be considered in force for the original response as well as for any additions or changes to this Project.

2.2 GROUNDING AND BONDING BUSBARS

A. Primary Bonding Busbar (PBB):

1. Electro-tin plated ¼" thick copper bar
2. Insulated stand-offs
3. 19 pairs of 5/16" holes and 3 pair of 7/16" holes
4. 4 inches high x 15.5 inches wide
5. Provide Erico Electrical Products TMGB-A16L19PT or approved equal.

    a. Additional approved manufacturers: Chatsworth, Panduit.

B. Secondary Bonding Busbar (SBB):

1. Electro-tin plated ¼" thick copper bar
2. Insulated stand-offs
3. 8 pairs of 5/16" holes and 3 pair of 7/16" holes
4. 2 inches high x 15.5 inches wide
5. Provide Erico Electrical Products TGB-A16L08PT or approved equal.

    a. Additional approved manufacturers: Chatsworth, Panduit.

2.3 BONDING CONDUCTORS

A. All bonding conductors shall be green insulated copper. Unless otherwise specified, size conductors as required by NEC and referenced standards.

B. The Telecommunications Bonding Conductor (TBC) shall be as a minimum the same size as the largest TBB.

C. The Telecommunications Bonding Backbone (TBB) and Secondary Bonding Conductor (SBC) shall be a minimum # 6 AWG.

D. The Backbone Bonding Conductor (BBC) shall be minimum # 8 AWG.

2.4 CONDUCTOR TERMINATIONS

A. Two hole compression lugs:

1. Two Hole Lugs Long Barrel Type with window.

a. Shall be Tin plated copper
b. Inspection window to assure conductor insertion
c. NEMA hole sizes and spacing
d. Coded on barrel for correct die selection
e. Provide Panduit LCC series or approved equal.

1) Additional approved manufacturer(s):

a) Erico Electrical Products
b) Thomas and Betts
c) Burndy

B. Hardware

1. Paint Piercing Grounding Washer Kit

a. Color coded Green
b. Penetrates painted surfaces to provide electrical connection
c. Shall be supplied with antioxidant compound
d. Provide Panduit RGW Series or approved equal.

1) Additional approved manufacturer(s):

a) Erico Electrical Products
b) Thomas and Betts
c) Burndy

2. Thread Forming Bonding Screws

a. Shall be Black
b. Penetrates painted surfaces to provide electrical connection
c. Shall have “Phillips” head
d. Provide Panduit RGTBS Series or approved equal.

1) Additional approved manufacturer(s):

a) Erico Electrical Products
b) Thomas and Betts
c) Burndy

C. Conductor Taps

1. “H” style conductor taps

a. Slotted design
b. Matching clear covers to meet UL 94V-0 flame retardancy
c. UL and CSA rated up to 600v
d. Provide Panduit HTWC Series or approved equal.

1) Additional approved manufacturer(s):

a) Erico Electrical Products
b) Thomas and Betts
c) Burndy

2.5 LABELS

A. Caution Label

1. Shall read:

IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER

a. Provide Panduit LTYK or approved equal.

1) Additional approved Manufacturers: Brady, Hellerman/Tyton

PART 3 - EXECUTION

3.1 INSTALLATION

A. Work shall be installed in accordance with these specifications and related Drawings and all manufacturers recommended installation practices.

B. Ground electrical systems and equipment as required by code, utility, local ordinances, and requirements herein.

C. Bonding conductors shall be continuous and routed in a direct path to the point of termination.

D. All grounding busbars shall be isolated from the structure support by a 2 inch minimum separation using manufacturer’s recommended insulating stand-offs and hardware.

E. Clean grounding busbars before terminating conductors.

3.2 LABELING

A. Label the ends of all conductors as indicated.

1. Label the SBCs consecutively within each closet SBC-01 through SBC-xx with “xx” representing the last number in order.

B. Label all PBBs and the SBB as indicated.

3.3 CONNECTIONS

A. Bond the PBB to the service equipment (power) ground, typically located in the electrical entrance facility, using the most direct route possible to minimize conductor length.

B. Bond all SBBs to the PBB using specified conductor.

C. Whenever two or more SBBs are used in a multi-story building, bond them together on the top floor and at every third floor, at a minimum, with a BBC.

D. Bond the following to the TMGB:

1. Telecommunications panel board:

   a. Alternating Current Equipment Ground Bus (ACEG), if equipped, or its enclosure.

2. Building structural steel, if exposed. (Steel rebars of reinforced concrete are not required to be bonded.)
3. Metallic equipment racks and ladder rack.
4. Cable shields.
5. All metal raceways and cable trays for telecommunications cabling extending from the same room or space where the PBB is located.
6. Floor tile ground tab if provided.
7. Others as identified on the Drawings.

E. Bond the following to the SBB when present:

1. Telecommunications panelboard: Alternating Current Equipment Ground Bus (ACEG), if equipped, or its enclosure.
2. Building structural steel, if exposed. (Steel rebars of reinforced concrete are not required to be bonded.)
3. SBBs within the same space if provided.
4. SBBs terminated on the same floor to other SBBs.
5. Metallic equipment racks and ladder rack.
6. Cable shields.
7. All metal raceways and cable trays for telecommunications cabling extending from the same room or space where the PBB is located.
8. Floor tile ground tab if provided.
9. Others as identified on the Drawings.

F. Terminate conductors with two-hole compression lugs.

3.4 BONDING

A. General:

1. 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.
2. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
3. Make connections with clean bare metal at points of contact.

    a. Utilize Bonding screws and Paint piercing Grounding washer Kits to attach painted surfaces.

4. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.
5. Utilize H-Tap compression fittings with clear insulating covers to tap cables.

B. Exothermic welded connections:

1. Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Tightening:

1. Tighten grounding and bonding connectors and terminals in accordance with the manufacturer's published tightening methods and practices. Where manufacturer's requirements are not indicated, tighten connections to comply with UL 486A and UL 486.

D. Compression-type connections:

1. 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:

1. Where insulated ground conductors are connected to ground rods, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

END OF SECTION

TEST RESULTS DATA SHEET

Project Name:_____

Crew Members:_____

_____

Test Date:_____

Tester Used:_____

Current (High\Low)_____

Serial Number:_____

Filter (On\Off)_____

Frequency (Hz)_____

TGB Identification:_____

Reference Test Resistance:_____Ω

Ground Reference System Continuity Test Data					
TGB		TGB with Panelboard Ground		TGB with Panelboard and Building Steel Ground	
Reference	Test (Difference)	Reference	Test (Difference)	Reference	Test (Difference)
Ω	Ω	Ω	Ω	Ω	Ω

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Provide complete standards compliant cabling support pathways and spaces as required by referenced standards for all communications cabling.

B. Primary pathways are those supporting the cabling infrastructure from the Equipment Rooms/Telecommunications Rooms through the corridors and chases to the secondary pathways.

C. Secondary pathways are those supporting the cabling infrastructure from the primary pathway to telecommunications outlets. Size all secondary pathways to accommodate a minimum of four horizontal cables.

D. Section Includes:

1. Raceways
2. Fittings
3. Boxes
4. Penetrations
5. Pathway accessories

E. Related Sections

1. All Division 27 Sections

F. Related Drawings

1. All Division 27 Drawings

1.3 REFERENCES

A. See “Common Work Results for Communications.

1.4 GENERAL INFORMATION

A. NFPA Compliance:

1. Comply with NFPA 70 “National Electrical Code” for components and installation.

B. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

C. UL Compliance:

1. Cable tray shall be UL certified.
2. Sleeves shall be UL listed assemblies.

D. All Work shall fully comply with these Specifications and related Drawings and all manufacturers' recommended installation practices.

PART 2 - PRODUCTS

2.1 PRODUCT STANDARDS

A. General:

1. Part II is designed to provide the Contractor with a minimum standard of quality and functionality for the products used for telecommunications infrastructure.

a. This standard will be considered in force for the original response as well as for any additions or changes to this Project. Due to this, there may be items listed in the "Products" section that are not required under the Scope of this Contract.

2.2 RACEWAYS

A. Conduits

1. Rigid steel conduit:

a. Threaded rigid steel conduit shall be manufactured from mild steel, zinc galvanized both inside and outside including threads. It shall be constructed in accordance with ANSI C80.1, Federal Specification WW-C-581; UL listed.

2. Intermediate metallic conduit:

a. Threaded intermediate metallic conduit shall be manufactured from mild steel, zinc galvanized both inside and outside including threads. It shall be constructed in accordance with ANSI C80.6, Federal Specification WW-C-581; UL listed.

3. Electric metallic tubing:

a. Electric metallic tubing shall be manufactured from mild steel, zinc galvanized both inside and outside. It shall be constructed in accordance with ANSI C80.2, Federal Specification WW-C-563; UL listed.

4. Flexible metallic conduit:

a. Unless otherwise indicated, flexible metallic conduit cannot be provided for communications cabling pathway.

5. Non-metallic raceways:

a. Polyvinlychloride (PVC):

1) PVC conduit shall be Schedule 40. It shall be constructed in accordance with NEMA TC2 and Federal Specifications W-C-1094A.

B. Surface raceways:

1. Single compartment raceway:

a. Single compartment raceway as indicated, surface mounted base with cover.

1) Provide appropriate elbows, tees, entrance end fitting, etc. to follow wall layout. Provide wire retainers at a minimum of every three feet and as necessary to contain cabling.
2) Approved manufacturers: Panduit, Wiremold, Hubbell

2. Two compartment raceway:

a. Dual channel raceway as indicated, two-piece surface mounted with snap on cover, compartment for power, and compartment for data.

1) Provide appropriate elbows, tees, entrance end fittings, etc. as recommended by the manufacturer. Provide wire retainers at a minimum of every three feet and as necessary to contain cabling.

a) Approved manufacturers: Panduit, Wiremold, Hubbell

C. Telecommunications/power poles:

1. Construction:

a. Two compartment.
b. 10 foot – 5-inch height and 2 ½ inches x 2 5/16-inch overall width.
c. Removable covers.

2. Provide mounting hardware, entrance end fitting, and ceiling trim plate.

a. Additional approved manufacturer: Panduit, Wiremold, Hubbell

D. Cable tray:

1. Wall Mounted

a. Provide cable tray sized and located as indicated on the Drawings.

b. Cable tray shall comply with NEMA 8B, 12B, or 12C. Cable tray and all fittings and accessories shall effect a complete structural system in the form of a rigid mechanical tray of compatible material and design, functional to support all cabling.
c. Provide aluminum, rectangular tube, center spine with rungs perpendicular to the spine and spaced 6 inches on center.
d. Prefabricated structure consisting of a longitudinal rail with transversely connected members (rungs) that project from one side; single or double tiered; aluminum alloy.
e. Provide gray-colored manufacturer's rung caps on all rungs.
f. Sections to be joined by bolted splice connectors.
g. 4 inches overall depth per tier, 6 inches rung spacing.
h. Rung ends shall be factory bent upward to a height as indicated on the Drawings.
i. The rungs shall be positioned at the side of the spine such that the spine is not part of the cable laying area.
j. Provide all manufacturer recommended fittings and accessories for a complete and functional system as indicated.

1) Accessories: Provide crosses, tees, angles, wyes, drops, rises, etc., and other accessories required for the installation specified.
2) Provide waterfall fittings in every location that cable is designed to exit the tray downward at the end of a run or between the rungs.
3) Support with threaded rod and U-channel supports systems (See Accessories, Supporting Devices – Field Fabricated)

k. Approved manufacturers include: Erico, B-Line, Panduit, Mono Systems, Allied Support Systems, B-Line.

2. Center Hung

a. Provide cable tray sized and located as indicated on the Drawings.
b. Cable tray shall comply with NEMA 8B, 12B, or 12C. Cable tray and all fittings and accessories shall effect a complete structural system in the form of a rigid mechanical tray of compatible material and design, functional to support all cabling.
c. Provide aluminum, rectangular tube, center spine with rungs perpendicular to the spine and spaced 6 inches on center.
d. Prefabricated structure consisting of a longitudinal rail with transversely connected members (rungs) that project from both sides; aluminum alloy.
e. Provide gray-colored manufacturer's rung caps on all rungs.
f. Sections to be joined by bolted splice connectors.
g. 4 inches overall depth per tier, 6 inches rung spacing.
h. Rung ends shall be factory bent upward to a height as indicated on the Drawings.
i. The rungs shall be positioned at the side of the spine at the top such that the spine is not part of the cable laying area.
j. Provide all manufacturer recommended fittings and accessories for a complete and functional system as indicated.

1) Accessories: Provide crosses, tees, angles, wyes, drops, rises, etc., and other accessories required for the installation specified.
2) Provide waterfall fittings in every location that cable is designed to exit the tray downward at the end of a run or between the rungs.
3) Support with threaded rod and U-channel supports systems (See Accessories, Supporting Devices – Field Fabricated)

4) Approved manufacturers include: Erico, B-Line, Panduit, Mono Systems, Allied Support Systems, B-Line.

E. Open-top individual cabling support: Where necessary, provide additional cable support to create a re-usable pathway for Communications cables:

1. General

a. Cable supporting devices manufactured with small round surfaces (i.e. bridal rings) are not acceptable.
b. Plenum rated
c. Complies with UL, cUL, NEC, and ANSI/TIA/EIA requirements for structured cabling systems.
d. Shall be mounted to building structure or suspended by threaded rod from the deck above approximately 12" above suspended ceiling.
e. Support with threaded rod and U-channel supports systems

2. Primary pathways

a. Open top cable supports

1) Properly sized.

a) Multiples of J-Hooks (80 cables each) appropriate to handle the required cable quantities plus 25% spare capacity.
b) Multiples of J-Hooks (300 cables each) appropriate to handle the required cable quantities plus 25% spare capacity.
c) Provide for primary pathway cable support.
d) Approved manufacturers: Erico, B-Line, Panduit, Mono Systems, Allied Support Systems, B-Line.

3. Secondary pathways.

a. Open top cable supports.
b. Accommodates up to 16 horizontal UTP cables.

1) Approved manufacturer(s): Erico, B-Line, Panduit, Mono Systems, Allied Support Systems, B-Line.

2.3 FITTINGS

A. Rigid steel or intermediate metallic conduit:

1. Fittings shall be threaded zinc galvanized steel.
2. At least one bushing shall be grounding type

a. Equipped with a ground lug
b. Provide on each conduit or sleeve where surface extends below ceiling line.

B. Electric metallic tubing:

1. Fittings shall be compression type.
2. At least one bushing shall be grounding type

    a. Equipped with a ground lug
    b. Provide on each conduit or sleeve where surface extends below ceiling line.

C. Non-metallic conduit:

1. Fittings shall be of the same type and manufacturer as the raceway, connected in accordance with manufacturer's written instructions.

D. Expansion:

1. Expansion fittings shall be of a type suitable for the particular condition and shall be complete with bonding jumper.

2.4 BOXES

A. Outlet boxes:

1. General:

    a. Stamped steel, code gauge, galvanized, minimum 2 ½ inches deep.
    b. Provide single or double gang outlet boxes as indicated.

2. In masonry or tile walls:

    a. Rectangular boxes, 4" square, with square corners minimum 2 ½ inches deep where the box is at the end of the run.

        1) Provide 1" deep single or 2 device trim ring.

    b. Rectangular boxes, 4 11/16" square, with square corners minimum 2 ½ inches deep where the box is in a continuing run.

        1) Provide 1" deep single or 2 device trim ring.

3. In gypsum board walls

    a. Single and dual gang outlet boxes with a depth of 3 to 3.5".

4. Surface mounted and exterior use:

    a. Single or dual gang Cast aluminum boxes with threaded hubs

5. No through-wall boxes or utility boxes will be accepted.
6. Where surface raceway is indicated, provide outlet boxes designed for use with the raceway by the same manufacturer as the surface raceway.

B. Junction boxes:

1. Covers shall be screw attached (unless otherwise noted on the drawing) and of same type of material as the box. All covers shall be easily accessed.
2. Boxes in exterior or moist locations shall meet NEMA 3R (at minimum)

    a. The box must meet the NEMA requirements for the atmospheric condition in which the box is installed.

3. Surface raceway boxes

    a. Where surface raceway is indicated, provide junction boxes by the same manufacturer as the surface raceway.

C. Pull boxes:

1. Required after every 100’ and after 180 degrees of bends in a conduit run
2. Shall be sized as follows:

    a. One 4” conduit straight through pull:

        1) 15” wide, 60” long, and 8” deep; minimum.
        2) Add 8” to the width for each additional conduit.
        3) Information about other trade sizes; reference EIA/TIA 569 standard.

2.5 ACCESSORIES

A. Pull rope:

1. Pull ropes shall be nylon type and sized accordingly.
2. Provide in all conduits, sleeves, raceways, and all cabling pathways for future use.

    a. Approved manufacturers: Arnco, Greenlee, Condux

B. Fiber optic innerduct:

1. NEMA TC 5, UL listed, corrugated, specifically designed for optical fiber cable pathways.

    a. Fiber optic innerduct shall be orange in color
    b. Innerduct shall be 1-inch minimum inside diameter, and a minimum pulling strength of 600 pounds.
    c. Each innerduct shall include a factory installed pull rope
    d. Innerduct shall be suited for the environment in which it is installed.
    e. Provide where fiber is installed.

        1) Approved Manufacturers: Arnco, Carlon, Endot, Opti-Com, Pyramid

C. Cable spillways

1. Provide cable spillway on all sleeved penetrations to support and protect the bend radius of cabling transitioning from sleeved penetration to cable tray/ladder rack.

a. Approved manufacturers: Bejed, B-Line, Panduit

D. Labels

1. Provide pathway labeling as specified in referenced standards.

a. Approved manufacturers: Brady, Panduit, Hellerman-Tyton

E. Penetrations

1. Provide UL listed devices for all penetrations through floors and walls for the purpose of housing communications cabling.

a. Provide all penetrations with a sleeve assembly designed to match or exceed fire rating of the wall or floor.
b. Approved manufacturers: Unique Fire Stop Products (USFP), Specified Technologies E-Z Path, Wiremold FS Series

PART 3 - EXECUTION

3.1 GENERAL

A. Minimum raceway size shall be as necessary to comply with fill ratio of referenced standards, but in no case less than one inch (1 inch).

B. Provide specified pull ropes in all cabling pathways.

C. Ground and bond all systems in accordance with the NEC and ANSI/TIA/EIA 607.

D. All installation material and practices shall fully comply with NFPA 70 “National Electrical Code” and ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces.

E. Coordinate work with the building structural systems and electrical installation.

F. All work shall fully comply with these Specifications and related Drawings and manufacturers’ recommended installation practices.

G. G.Exposed cabling is not allowed. Provide conduit to house all cabling that is not concealed in walls or assessible ceiling spaces.

3.2 PATHWAY INSTALLATION

A. Raceways

1. Conduit Usage:

a. Rigid Galvanized Steel (GRC):

1) All exposed conduit installed above grade outside the building envelope.
2) All conduits installed in moist locations.

b. Electric Metallic Tubing (EMT):

1) All conduits within the building envelope.

c. Polyvinylchloride (PVC):

1) Underground which may continue from underground through floor slab to Equipment Room/Telecommunications Room.

2. Conduit installation:

a. Provide all conduit terminations with locknuts and bushings. Provide conduits 1 ½ inches and larger with insulating bushings and locknuts inside and outside the enclosure.

1) At least one bushing per conduit shall be grounding type

a) Equipped with a ground lug
b) Provide on each conduit or sleeve where surface extends below ceiling line and install Bonding Conductor to TMGB.

b. Support conduits by pipe straps or trapeze hangers. Space supports not more than 8 feet on center. Secure supports by means of toggle bolts, inserts or expansion bolts.
c. Space wall brackets supporting conduits not more than 4 feet 6 inches on center. Secure supports by means of toggle bolts, inserts or expansion bolts.
d. Support conduits directly from structural systems not from ceiling suspension systems.

1) Provide additional support at junction or pull boxes.

e. Wherever possible, conceal raceways under floors, in walls, above ceilings or in furred spaces in finishes areas.
f. Support single conduits 1 ½ inches and larger by means of rod and cast ring hangers. Support multiple runs in similar manner or use common trapeze hanger.

1) Trapeze hanger:

a) Unistrut P2000 or P4000, or equal by Allied Support systems or Superstrut, as required for span and loading.
b) Provide end caps on hangers.
c) Fasten conduits by means of heavy galvanized straps.

g. Provide two-hole sheet metal pipe straps for all surface mounted conduit supports on walls up to a height of 8 feet above the finished floor. Pinch type hangers similar to minerallac type may only be used at heights greater than 8 feet.
h. Protect conduits during construction with temporary plugs or caps. Securely cap all conduit until wire or cable is installed.
i. Minimum conduit size is 1 inch.
j. Do not install conduit in concrete slab.

k. Provide expansion fittings where raceway crosses the building expansion joints. (O.X. Type AX, EX, EXDS, TX, EXE, or approved equal).
l. Route and maintain conduits as shown on the Drawings.

1) If no specific routing information appears on the Drawings, the routing shown shall be considered diagrammatic.

a) In such a case, the Contractor shall coordinate his Work with the different trades so that interferences between conduit, cable tray, piping, equipment, architectural, and structural work shall be avoided.

i) Should an interference arise, the Contractor shall inform the Consultant before proceeding with the Work.
ii) Should the Contractor fail to contact the Consultant and interferences develop, the Owner's Representative will decide which equipment, piping, etc. must be replaced, regardless of which was installed first. The relocation shall be performed at no expense to the Owner.

m. There shall not be more than the equivalent of 180 degrees of bends in any single run of conduit between adequately sized pull.
n. Conduit bends

1) Bends shall be made so that the conduit will not be flattened or kinked and the internal diameter of the conduit will not be reduced.
2) The radius of the curve of the inner edge of any bend shall not be less than as indicated by the National Electrical Code and ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces.
3) In no case shall any conduit be bent or any fabricated elbow be applied to less than the allowable bending radius as specified by the cable manufacturer of the installed conductor.
4) When necessary to make field bends, use tools designed for conduit bending.

a) Heating of metallic conduit to facilitate bending is not permitted.

o. A conduit run shall not be longer than 100' between pull boxes for conduit runs inside a building.
p. The Contractor shall not cut, burn, or drill any structural member to mount electrical equipment or to facilitate tray or conduit installations without having previously received approval, in writing, from the Architect/Engineer/Consultant.
q. Mount all conduits a minimum of 7 inches above any accessible type ceiling.
r. Maintain conduit runs at least 6 inches from insulated pipes, steam lines or any other hot pipes they pass. Where the lines are not insulated, the clearances shall be increased until the temperature of the conduit, with no live conductors enclosed, does not rise above the ambient temperature of the installation area.
s. Conceal all raceways except where otherwise indicated.

1) Provide flashing and counter-flashing or pitch pockets for waterproofing of all raceways, outlets, fittings, etc. that penetrate the roof.
2) Route all raceways parallel or perpendicular to the building lines with symmetrical bends.

3) Provide sleeves in forms for new concrete walls, floor slabs, and partitions for passage of raceways.

a) Seal in an approved manner all raceway openings and sleeves through fire rated walls, floors, and ceilings after raceway installation.

t. Waterproof all sleeved raceways where required.

B. Surface Raceway

1. Surface raceway installation

a. Provide surface raceways as indicated.
b. Coordinate installation with casework before installation. Field verify lengths to be installed before ordering equipment.
c. Install plumb and level.
d. Anchor all raceways to walls with the anchors designed for that particular wall construction. Secure raceway at a minimum of every 2 feet and not less than 6 inches from raceway ends.
e. Install raceway per the manufacturer's written recommendation, including necessary entrance, end and bend fittings.
f. Provide all of the manufacturer's recommended fittings and accessories.
g. Where surface raceway is provided for a secondary pathway from the outlet to the ceiling space, extend surface raceway into the ceiling space not less than 4 inches.

C. Telecommunications/power poles

1. Mount straight and anchor to building structure above the ceiling line.
2. Provide mounting hardware, entrance end fitting, and ceiling trim plate.

D. Cable Tray

1. Planning

a. Contractor shall plan entire cable tray system layout and all components required to provide a complete system, verifying dimensions and right-of-way clearances as needed.
b. Design

1) Wall mounted

a) Where 12" capacity is indicated on the drawings a single tiered 12" rung size tray will be utilized.
b) Where 24" capacity is indicated on the drawings a two tiered 12" rung size tray will be utilized.

2) Suspended

a) Where 12" capacity is indicated on the drawings a double sided 6" rung size tray will be utilized.

b) Where 24" capacity is indicated on the drawings a double sided 12" rung size tray will be utilized.

2. Coordination and positioning

a. Coordinate positioning with other trades to assure maximum accessibility.

1) Tray shall be mounted securely along the wall at a minimum of 6" (lower tier) above the ceiling line.

a) Where two 12" trays connect to a two-tier unit, the upper tray may continue at 12" (upper tier) above the accessible ceiling.
b) Where tray cannot be wall mounted, (traversing hallways, etc.) mount span securely to wall at each end and provide ½" threaded rod supports, anchored into the concrete deck above, every 4' at minimum.

2) Minimum access should be 12 inches clear above the tray (each tier) and 12 inches clear beside the tray to facilitate moves, adds and changes for telecommunications cabling.

3. Installation

a. Cable tray shall be routed as shown schematically by Contract Documents, run level and true to building lines.
b. Changes in direction, changes in elevation, tees, crosses, and bends shall be made with manufactured fittings and accessories.
c. Where conduits terminate above a cable tray, the conduit shall be provided with an insulating bushing.
d. Mounting heights shall be sufficient to clear light fixtures, piping, and equipment and permit ready access through lay-in ceiling grids. Do not install less than 6 inches above ceiling.
e. Cable tray shall be grounded by a separate stranded #6 AWG copper ground conductor attached to the building grounding electrode system and connected to nearest section of the cable tray with UL approved aluminum/copper termination.

1) See "Grounding and Bonding" specification for further details.

f. Cable tray shall be installed in accessible area. Provide raceway system of equivalent cross section area of cable tray where ceiling system is not accessible.
g. Cable tray and all fittings and accessories shall effect a complete structural system in the form of a rigid mechanical tray of compatible material and design, functional to support all cabling.
h. Transition cable tray system around physical obstructions using manufacturer's recommended turns, sweeps, transition products, and materials to create a complete continuous cabling pathway free of obstructions and maintaining specified clearances.
i. Where physical discontinuity is necessary, mechanically support cabling over the discontinuity as specified. Bond the ends of the cable tray together electrically over any discontinuity.

1) Fire-wall penetrations shall be made with 4" sleeves (4 per 12" of tray width minimum).

a) Utilize requirements of the NFPA NEC to determine correct construction and sizing of wall penetration if tray is to penetrate fire rated wall.

2) Ground and bond the system in accordance with the NEC and ANSI/TIA/EIA 607.
3) Do not use copper fittings or hardware to connect any bonding conductor to aluminum cable tray.

j. Provide support for cable trays at a minimum of 4’ 6” on center and at all splices, tees, elbows, bends, intersections, and transitions.

1) Support with threaded rod and U-channel supports systems

a) 12” width – ½” ATR; 24” width – 5/8” ATR

2) Rod lengths over 6’ will require a “Rod Stiffener” installation.

a) A section of U-Channel stock is placed around the rod and stiffener clamp assemblies used to clamp to rod

i) Place clamps a minimum of 6” from the top and bottom of the rod and every 18” in between.

k. Install system free of all sharp edges, burrs, or projections.
l. Provide rung caps on rung ends as specified.
m. Provide waterfall fittings in every location that cable is designed to exit the tray downward at the end of a run or between the rungs.
n. Route parallel and perpendicular to building surfaces.
o. Mount cable tray in such a fashion as to be re-usable.

1) Install as straight and flat as practical and perpendicular to building lines.

a) Utilize manufactured 45 degree transitions up and down to change elevations.
b) Utilize manufactured 45 or wide sweep 90-degree fittings to change route.

i) Mount cable tray at approximately 6-12” above accessible ceiling.
ii) Locate in a position to allow at least 12” clearance on each side of the cable tray for access.

4. Install as a complete system in accordance with manufacturer’s installation instructions indicated on the Drawings and to ensure electrical continuity of the system and adequate support for the cabling. Provide all manufacturer’s recommended fittings and accessories.
5. Supports shall be attached to building structure.

E. Open top discreet cable supports (J-Hooks)

1. Primary pathways (corridors, vertical chases, etc.) plenum rated, adjustable cable support that complies with UL cUL, NEC, and ANSI/TIA/EIA requirements for structured cabling systems and accommodates up to 425 horizontal UTP cables or multiples of CAT32 (80 cables each) appropriate to handle the required cable quantities plus 25% spare capacity.

a. Install j-hook pathway, supporting at least every 5', as straight as possible perpendicular to building structure at approximately 12" above accessible ceiling.
b. Attachment of J-Hooks must be to building structure directly or utilize a minimum of ¼" all-thread rod anchored into deck above.

2. Secondary pathways (those extending from the primary pathways to the space above the telecommunications outlets) J-hooks with galvanized finish to provide smooth surface and corrosion resistance that complies with UL, cUL, NEC, and ANSI/TIA/EIA requirements for structured cabling systems and accommodates up to 16 horizontal UTP cables.

a. Install j-hook pathway, supporting at least every 5', as straight as possible perpendicular to building structure at approximately 12" above accessible ceiling.
b. Attachment of J-Hooks must be to building structure directly or utilize a minimum of ¼" all-thread rod anchored into deck above.

3.3 BOXES

A. Outlet boxes:

1. Provide outlet boxes flush with the surface unless otherwise noted and properly centered in ceiling tiles, wall finishes, or casework elements. Heights as indicated or to match existing outlet boxes.

a. Install all telecommunication video outlet with control for locations indicated to be wall hung TV's or monitors 8 feet above finished floor or 12 inches below finished ceiling, whichever is lower.

2. Provide outlet boxes of a type appropriate for the use and location. Gang adjacent devices in multiple gang boxes under a common finish plate.
3. Boxes shall be securely and rigidly attached and supported plumb, level, and true to building lines by any of the following methods:

a. Double bar installation for metal stud walls. Bar hanger punch, mounting clips, and retainer clips shall be used in strict accordance with manufacturer's instructions. Factory pre-punched stud holes shall not be used to support the bar hangers.
b. Steel stud installed behind box for support without caddy-type mounting clips for metal stud wall construction.
c. Caddy screw gun bracket installed behind box for support. Installation shall be per manufacturer's instructions.

4. Finish plates shall not span different types of wall finishes either vertically or horizontally. Plates shall cover mortar joints and cut openings completely.
5. Outlet, junction, and pull boxes and their covers shall have corrosion protection suitable for the atmosphere in which they are installed. Provide gaskets for all boxes installed outside or in other wet or damp locations (tunnels, crawlspaces, pits, etc.).
6. Outlet boxes shall be protected from plaster. Debris shall be thoroughly cleaned from the box before installation of conductors.
7. Floor boxes shall be installed flush and true with the floor.
8. Finish plates:

a. Install a blank cover plate for each new or existing unused outlet box.

B. Junction and pull boxes

1. Provide junction and pull boxes as indicated in the Contract Documents and as required.
2. Provide junction and pull boxes in accessible spaces or behind access panels. Boxes located above snap-in or lay-in removable ceilings will be considered accessible.
3. Provide junction and pull boxes where necessary to facilitate the installation of raceways and pulling of wire or cable.
4. Provide junction and pull boxes sized in accordance with NEC and installed such that conduit entry will permit the longest radius for conductors contained therein.
5. Provide junction and pull boxes such that conduits enter and exit across from each other on opposite sides of the junction box. Do not provide junction and pull boxes in place of conduit bends.
6. Support all such boxes in accordance with the National Electrical Code.

C. Mounting heights

1. Exceptions:

a. At junction of different materials in wall finishes.
b. Where outlet would occur in moldings, break in wall surface or unsuitable location in the tile, wood, or similar finish.
c. Where outlets would conflict with locations of wall-mounted equipment such as radiators, convectors, unit heaters, etc.
d. As noted otherwise.
e. Where electrical outlet on that wall is of different height.

3.4 PENETRATIONS THROUGH FLOORS AND WALLS

A. General:

1. Provide, locate and set sleeves where conduit passes through floors, walls, and other concrete or masonry structural materials except where tunnels, chases or shafts are provided in the constructions.

a. Sleeves through poured-in-place concrete floors shall be set before the pour and shall be of a design that will seal against passage of water between sleeves and concrete floor.

2. Provide bushings on all conduit sleeves.
3. Extend all wall sleeves a minimum of 2 inches or as required to allow the installation of conduit bushings.
4. Extend floor sleeves 4-6 inches above finished floors unless otherwise specified.
5. The void between the sleeve wall and conduit shall be neatly filled with an approved fire stop material.

B. Quantity and sizing:

1. Penetrations through floors, access through walls of Equipment Rooms and/or Telecommunications Rooms, and obstructions along a backbone or primary horizontal cabling route.

    a. Provide the required quantity of 4-inch sleeve assemblies as specified with a minimum of one 4-inch sleeve. Properly firestop after installation of the telecommunications cabling.
    b. Install sizes and quantities as specifically noted on the prints, or the quantity required so as to accommodate all planned cables, not exceeding a 40 percent maximum fill ratio in each sleeve, plus one spare 4-inch sleeve.

2. Penetrations through walls or along secondary horizontal cabling routes.

    a. Provide a 2 inch or 4-inch sleeve assembly as specified with a minimum of one 2-inch sleeve. Properly fire stop after installation of the telecommunications cabling.
    b. Install sizes and quantities as specifically noted on the prints, or the quantity required so as to accommodate all planned cables, not exceeding a 40 percent maximum fill ratio in each sleeve, plus one spare 4-inch sleeve.

C. Construction:

1. All penetrations through floors or walls to allow Division 27 cable or pathway to pass through will require a UL listed device for the purpose of penetrating the construction.

    a. Concrete, block, brick, and gypsum drywall construction providing a fire rating of greater than one hour for walls and floors will require a UL rated sleeve assembly installed to manufacturer's requirements allowing the penetration(s) to not degrade the designed fire rating of the wall or floor.

        1) Each penetration will require a UL listed sleeve assembly installed by an installer trained on proper installation of the sleeving device.
        2) Each penetration shall have the accompanying certification paperwork completely filled out and attached to the building structure adjacent to the penetration.

2. All other penetrations and gypsum drywall constructed walls providing a fire rating of one hour or less will require a UL rated sleeve assembly installed to manufacturer's requirements allowing the penetration(s) to not degrade the designed fire rating of the wall or floor.

    a. Each penetration will require a UL listed sleeve assembly installed by an installer trained on proper installation of the sleeving device.
    b. Each penetration shall have the accompanying certification paperwork completely filled out and attached to the building structure adjacent to the penetration. A copy of this paperwork will be required in the O & M Manual.

3. All penetrations found to be improperly sleeved after the installation of cabling will be sleeved and firestopped to restore the proper aesthetics and required fire rating to the obstruction.

    a. Each penetration will require a UL listed sleeve assembly installed by an installer trained on proper installation of the sleeving device.

b. Each penetration shall have the accompanying certification paperwork completely filled out and attached to the building structure adjacent to the penetration. A copy of this paperwork will be required in the O & M Manual.

4. All penetrations required in gypsum board walls for installation of horizontal cabling, where conduit is not stubbed into the ceiling cavity for this purpose, will require a sleeved penetration through the drywall membrane or the wall cap.
5. Each penetration will require a UL listed sleeve assembly installed by an installer trained on proper installation of the sleeving device.

3.5 SUPPORTS

A. General:

1. 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.
b. Concrete and masonry anchors

1) Shall be a guaranteed anchoring system with field training available.

a) All onsite personnel will be required to be manufacturer trained on the anchoring system being utilized, and upon request, to show proof of manufacturer's training certification.

B. Manufactured supporting devices:

1. Raceway supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
2. Fasteners: Types, materials, and construction features as follows:

a. Expansion anchors: Carbon steel wedge or sleeve type
b. Toggle bolts: All steel springhead type
c. Powder-driven threaded studs: Heat-treated steel, designed specifically for the intended service

3. 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.
4. Cable supports for vertical conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored 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.
5. U-channel systems: 16-gauge 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.

C. Fabricated supporting devices:

1. General: Shop or field-fabricated supports or manufactured supports assembled from U-channel components.
2. Steel brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
3. Raceway supports: Comply with the NEC and the following requirements.

    a. Conform to the manufacturer's recommendations for selection and installation of supports.
    b. 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.
    c. 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.
    d. Support parallel runs of horizontal raceways together on trapeze-type hangers.
    e. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers for 1 ½ inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use ¼ inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
    f. 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.
    g. 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.

4. Conduit seals:

    a. 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.

5. Fastening:

    a. Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to; conduits, raceways, cables, cable traps, 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, machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. 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 ½ inch in reinforced concrete beams or to depth of more than ¾ inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3) Ensure that the load applied to any fasteners does not exceed 25 percent of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

6. Raceway supports: Hanger spacing shall be as required for proper and adequate support of raceway, but in no case shall be less than one hanger per 5 feet of raceway length.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 28 Specifications and Drawings.

1.2 SUMMARY

A. Basic materials, methods and installation guidelines applicable to the work of all Division 28 documents.

B. The information included in this Section apply too and are additional requirements for all of Division 28 documents.

C. Thoroughly review entire bid documents, including all drawings and specifications prior to bidding and include all indicated work in bid.

1.3 REQUIREMENTS

A. Project Coordination

1. Commence coordination immediately upon award of contract. Coordination includes providing and extracting related information to and from other trades for review. Failure to coordinate in a timely manner shall not result in any subsequent additional reimbursement, special allowances or additional construction time being made for any facet of the project. Work fabricated or installed before properly coordinating with all other trades shall be done at the Contractor's own risk.
2. Work in harmony with all building trades, so as not to cause any delays. Sequence, coordinate, and integrate installations of communications materials and equipment with all other applicable trades for efficient flow of the Work. In addition, contact and coordinate/facilitate work of local communications service providers for incoming communications services. Execute connections with local services providers complete as indicated.
3. The drawings indicate the approximate location and arrangement of required work. The drawings shall be followed as closely as possible in coordination and in execution of the work.
4. Participate in coordination efforts and in preparation of coordination drawings prior to fabrication or installation of any equipment, materials, etc. Coordinate actual clearances of all installed equipment.
5. Conflicts in equipment and materials shall be corrected prior to installation. Should there be a conflict with the drawings of other trades, work with the trades to correct the conflict while coordinating the project. If the conflict cannot be resolved, refer the matter to the

owner's representative for a final decision as to method or material. Refer to drawings of all other trades for details, dimensions and locations of other work and route their work so as not to conflict with any other branch. Any work installed or equipment placed in position by this contractor creating a conflict shall be readjusted to the satisfaction of the owner's representative at the expense of this contractor.

6. All products furnished of a given type shall be by a single manufacturer; shall bear the same brand name; shall be of the same finish color and texture; and shall be from the same product model series, unless otherwise noted.
7. Plans are diagrammatic indicating design intent and indicating required size, points of termination and, in some cases, suggested routes of raceways, etc. However, it is not intended that drawings indicate fully coordinated conduit routing, all necessary offsets, etc. Provide all cable assemblies, etc. as straight as possible and symmetrical (perpendicular to or parallel with) with architectural items and in a consistent elevation. Do not provide work installed diagonal to building members.

B. Product Data

1. Provide complete product master material list per individual specification section. Each product item must reference the specific paragraph for which the product is being submitted. See following example of product master material list:

Specification Paragraph	Manufacturer	Part Number	Description
2.2	Genetec	Autovu	License plate and vehicle recognition
2.3.B	Hanwha	PNM-9085RQZ	Multi-Sensor Camera
2.3.C	Hanwha	PRN-6400DB4	64CH 8K 400Mbps H.265 AI NVR

2. Provide the following information for each product:

   a. The manufacturer’s name (Brand) and full model number.
   b. Product Information Sheets “Datasheets”: Include catalog information, sizing, and technical data on each item to be used on the Project.
   c. Each product datasheet must reference the specific paragraph for which the product is being submitted. Each product must be listed in the exact same order as it appears in the Section for which the products are being submitted.
   d. Datasheets shall each include a clearly identifiable label applied in upper corner of each sheet that clearly references the specification section and drawing (as applicable) to which it applies. Labels shall be consistently affixed in the same location on all sheets unless the labels will obstruct pertinent technical information.

3. All datasheets shall be original manufacture datasheets, first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file), or high quality photocopy of original manufacturer's datasheets.
4. Where datasheets depict multiple products, versions or options, the Contractor shall highlight (indicate with an arrow) all applicable model(s), version(s) and option(s) applying to the specific product the Contactor will be providing. Exact catalog number must be indicated. The submitted items must be from "approved materials" as specified in each Specification Section.
5. Do not combine with submittals from any other Division.
6. Provide detailed schematic connectivity drawings as requested.

C. Operation and Maintenance Manuals

1. Prepare Operations and Maintenance Manuals in accordance with Division 1 Section "Maintenance and Operation." In addition to the requirements specified in Division 1, provide additional information as detailed in each Section and include the following information for equipment items:

    a. Contractor shall submit prior to 50 percent job completion four maintenance manuals. Manuals are to indicate all information relative to maintenance and operating instructions for all new electrical equipment.
    b. Operations and Maintenance (O&M) manuals shall be provided for each item of equipment. O&M submittals shall be submitted in expandable 3-ring binders. Binders shall contain a sufficient number of dividers to permit an orderly filing of submittals. Each divider shall be labeled as to contents. O&M submittals shall include but not be limited to the following:

        1) Installation instructions and schematic drawings.
        2) Operating and maintenance instructions.
        3) Complete parts list with manufacturer's model numbers.
        4) Complete set of approved shop drawings.
        5) Complete wiring diagrams showing all connections and internal wiring diagrams of all equipment, including module diagrams. Factory typical wiring diagrams are not acceptable.

D. Building Codes:

1. National Electrical Code (NFPA 70)
2. Life Safety Code (NFPA 101)
3. Uniform Building Code (Or adopted State Code)
4. Federal Communications Commission (FCC) Part 68
5. State specific agencies:

    a. Administrative Building Council
    b. State Board of Health
    c. State Fire Marshal

6. Local Codes (City, County, etc.)
7. Local Utility Company requirements

E. Standards

1. ANSI/TIA 568 Commercial Building Telecommunications Cabling Standard.
2. ANSI/TIA 569 Commercial Building Standard for Telecommunications Pathways and spaces.
3. ANSI/TIA 606 The Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings.
4. ANSI/TIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications.
5. ANSI/BICSI 007-2020, Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
6. ASIS – Physical Asset Protection (PAP)
7. ASIS – Security Awareness (SA)

F. Permits

1. Contractor shall obtain and pay for all permits or certificates of inspection and approval required for his branch of the work.
2. Permits shall be posted in a prominent place at the building site properly protected from weather and physical damage.

G. Definitions

1. Wherever the word “Install” appears on the drawings or in these Division 28 specifications it shall mean to supply all labor, tools and incidental materials necessary to handle, store, mount, terminate, program, configure and adjust product as necessary to fulfill project requirements.
2. Wherever the word "Provide" appears on plan drawings or in Division 28 specifications, it shall be interpreted to mean that the Contractor shall "Furnish and Install", including all necessary accessories, miscellaneous materials and labor necessary to render the respective system fully operational.
3. Wherever the word "Work" appears in Division 28 specifications or on communication technology drawings, it shall be interpreted to mean any and all labor, materials, accessories, services, etc. necessary to fulfill project requirements.
4. Wherever the word “Furnish” appears on the drawings or in these Division 28 specifications it shall mean to supply the specified labor or specified product, including all associated shipping, storage and warranty expenses.
5. Wherever the words “Site”, “Project Site”, or “Premises” appears in Division 28 specifications or its related drawings, it shall be interpreted to mean all real estate, buildings and structures where work will be performed and where products will be installed and reside.
6. Wherever the phrase “Standard of Quality” appears in Division 28 specifications or its related drawings, the Contractor shall interpret this to mean that the listed Manufacturer and Catalog number for each item has the physical, functional, and operational attributes to provide the designed functionality.
7. EAC – Electronic Access Control
8. VSS – Video Surveillance System

H. Quality Assurance

1. Contractor shall have a minimum of five (5) years' experience in the installation of Communication Technology system(s) of similar size, type, scope and contract value.
2. The lead technician(s) on the Project shall have a thorough understanding of the following:

    a. ANSI/TIA/EIA 568 Commercial Building Telecommunications Cabling Standard.
    b. ANSI/TIA/EIA 569 Commercial Building Standard for Telecommunications Pathways and spaces.
    c. ANSI/TIA/EIA 606 The Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings.
    d. ANSI/TIA/EIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications.
    e. ANSI/BICSI 007-2020, Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
    f. ASIS – Security Management Standard: Physical Asset Protection (PAP)
    g. ASIS – Facilities Physical Security Measures Guideline (FPSM)

3. Contractor shall be a (factory trained) certified installer for all systems provided in Division 28.

    a. This minimum requirement shall apply to each Division 28 section independently. If Contractor is incapable of meeting the percent of product value requirement for each section, Contractor shall use a Subcontractor that can meet the percent of product value requirement, in whole, for all products and work of that section for which This Contractor is not qualified.
    b. The specific Contractor or Subcontractor meeting the requirements for a specific section shall be responsible for the supply of the products, supplemental engineering services and submittals as well as performing all technical labor associated with the installation, training and warranty servicing of work of that section.

4. Contractor shall have substantial business operations located within a 100-mile radius of the project site with a full-time employee staff actively engaged in the supply, installation and service of systems and equipment of the type and scope herein specified.
5. Contractor shall have full-time employee service staff based within a 100-mile radius of the project site.
6. Contractor shall provide any additional information requested by the Owner as determined appropriate by the Owner to validate a Contractor's (or its Subcontractor's) ability to perform and warranty the specified work in the quality, manner and time frame required.
7. Superintendent/Project Manager

    a. This Contractor shall furnish the services of an experienced superintendent/Project Manager who shall be constantly in charge of the work, together with the qualified Foremen and specialists as required to properly install, connect, adjust, start, operate and test the work involved.
    b. The superintendent's/Project Manager's qualifications shall be subject to the review and acceptance by the Owner/Owner. Unless the Owner/Owner grants prior special permission, the same communication Superintendent/Project Manager shall be utilized throughout the duration of the project and be responsible for the complete scope of the Contract.

I. Product Delivery Requirements

1. The Contractor shall not procure, deliver or install any product until after the contractor's submittal has been reviewed by the Owner and the submittal has been returned to the Contractor's marked "Reviewed as Submitted" or "Reviewed as Noted". Advance procurement, delivery or installation of product prior to the return of submittal is entirely at the Contractor's own risk. Contractor should schedule its work and procurement accordingly.
2. Prior to procurement of any equipment or materials, Contractor shall review the model numbers, compatibility and interoperability of all products.
3. Prior to procurement, Contractor shall, through coordination with other trades and through field measurements and project site inspections, verify that products to be supplied can be physically installed as planned.
4. No claim for additional payment will be considered for the return of any equipment determined incompatible, or procured without adhering to the aforementioned conditions, including claim for reimbursement of manufacturer's "restock" fees.
5. Contractor shall factor all of these conditions into its bid and plan its scheduling and resource needs accordingly to ensure that all work shall be performed according to the Owner's schedule and requirements of this contract.

J. Product Storage and Handling Requirements

1. The Contractor is responsible for receiving, handling, storing, and protecting all materials used on this Project until Substantial Completion.
2. Pack components in factory-fabricated protective containers.
3. Units shall be delivered in sections of such size as will pass through available openings.
4. Until ready for installation, store products in original factory containers.
5. Products shall be stored in a clean, dry space and as additionally recommended by the product manufacturer.
6. Keep products out of the weather and away from construction traffic and debris, including drywall finish dust.
7. Do not exceed structural capacity of the floor or platform on which the products are stored.
8. Until final acceptance of the system, protect all supplied products from damage resulting from moisture, fumes, dirt, dust and debris or any other source of potential damage.
9. Handle all products with care before, during and after installation so as to prevent damage.
10. Replace any products damaged prior to final acceptance with new replacement products.
11. Replacement shall be at Contractor's expense.
12. Contractor is responsible for the safety and good condition of the materials and equipment installed until final acceptance by the Owner.
13. Save original product shipping containers and related packaging materials for major products until final acceptance.
14. Prior to disposal, check with owner to determine if the owner wishes any of the packaging materials.

K. Examination and Preparation

1. Contractor shall visit the Site to familiarize himself with the local conditions under which the work is to be performed and correlate his observations with the requirements of the Contract Documents. No allowance shall be made for claims for concealed conditions which the Contractor, in exercise or reasonable diligence in observations of the Site and review of the local conditions under which the work is to be performed, learned or should have learned of, unless otherwise specifically agreed by Owner and Owner in writing.

2. Before ordering any materials or doing any work, the Contractor shall verify all measurements and be responsible for correctness of same. No extra charge or compensation will be allowed for duplicate work or material required because of an unverified difference between an actual dimension and the measurement or size indicated in the drawings or specifications. Any discrepancies found shall be submitted in writing to the Project Manager and Owner for consideration before proceeding with the work.
3. This Contractor must verify all dimensions locating the work and its relation to existing work, all existing conditions and their relation to the work and all man-made obstructions and conditions, etc. affecting the completion and proper execution of the work as indicated in the Contract Documents.

L. Installation

1. Provide all required labor, materials, equipment and Contractor's services necessary for complete installation of systems required to comply with the requirements of authorities having jurisdiction, as indicated on Drawings, and as specified.
2. Work shall be functional and complete in every detail, including any and all items required to complete the system, whether or not these items have been enumerated or shown on the Drawings.
3. Special attention shall be given to access to working and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.
4. Each Contractor shall be fully knowledgeable of the details of all Work to be performed by other trades and take necessary steps to integrate and coordinate his Work with other trades.
5. Wherever tables or schedules show quantities of materials, they shall not be used as a final count. These figures serve only as a guide for the Contractor. Each Contractor shall be responsible for furnishing all materials on the Drawings or as specified.
6. The Consultant and Owner's Representative have full power to condemn or reject any Work, materials or equipment not in accordance with these Specifications and Construction Drawings or the manufacturer's specifications or drawings approved by the Owner or Consultant.
7. Work or equipment that is rejected shall be removed and replaced to the satisfaction of the Owner at the Contractor's expense. Work or equipment that is rejected shall be so stated in writing by the Owner or Consultant.
8. Such decisions that the Owner or Consultant may make with respect to questions concerning the quality, fitness of materials, equipment, and workmanship shall be binding upon the parties thereto.
9. All Work shall fully comply with these specifications and related Drawings and all manufacturers recommended installation practices.
10. All Work shall be performed with the best practices of the trade for performance, functionality, safety, endurance, and aesthetics.
11. Coordinate ordering and installation of all equipment with long lead times or having a major impact on work by other trades so as not to delay the job or impact the schedule.
12. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible, as appropriate to the application.
13. Set all equipment to accurate line and grade, level all equipment and align all equipment components.

14. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from premises when no longer required.
15. No equipment shall be hidden or covered up prior to inspection by the owner's representative. All work that is determined to be unsatisfactory shall be corrected immediately.
16. All work shall be installed level and plumb, parallel and perpendicular to other building systems and components.
17. Install all equipment and materials in strict accordance with manufacturer's written instructions. Bring any conflicts between the manufacturer's written instructions and these specifications to the attention of the Designer for recommendations.
18. Upon completion of installation of equipment and communication circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with re-testing.

M. Cutting and Patching

1. Where demolition of existing surfaces are required by the Work, the same shall be restored to at least as good a condition as they were before.
2. Contractor shall be responsible for painting, patching, repairing and replacing any building surface, furnishing, wall/floor/ceiling covering that is damaged or penetrated in the process of performing work on the project site.
3. Additional work required to repair work performed under this Contract shall be at the expense of This Contractor.
4. The Division 28 contractor shall do all cutting as required for the admission of Division 28 work. Unless directed otherwise in field, provide all related patching and painting to match surrounding methods, materials and colors. Any damage done by this contractor to the building during the progress of this contractor's work shall be made good at this contractor's expense.

N. Site Maintenance

1. During the progress of the work, the Contractor shall clean and leave the premises and all portions of the building in a clean and safe condition. This cleaning shall occur on a daily basis.

O. Final Cleaning

1. Clean all parts of the apparatus and equipment. Exposed parts, which are to be painted, shall be cleaned of cement, plaster and other materials and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all corners and cracks scraped out.

P. Closeout Requirements

1. Upon the Designer's receipt of and approval of the Contractor's pre-test submittal, the Contractor shall contract the Designer to schedule acceptance testing. Contractor shall allow not less than 10-business days of advance notice to the Owner.

2. In the presence of the Owner, the Contractor shall demonstrate the presence of all specified products, cabling and installation methods. The Contractor shall demonstrate the operation of the system (and any requested sub-component thereof) and shall be prepared to make any electronic, physical or software related adjustments to the system or any of its sub-components to the satisfaction of the Owner, as required to achieve full compliance with the specifications.
3. The contactor shall have available at the project site all test equipment, cables, tools and personnel necessary to demonstrate full compliance with these specifications as determined necessary by the designer.
4. During the acceptance testing the Contractor shall have a clean and fresh copy of the contractor's most up-to-date as-built record documentation, printed to scale.
5. This Contractor shall provide all required labor services required to completely verify and test the systems in the presence of the Owner.
6. Verify that each system, as a whole system, meets these Specifications and complies with all applicable standards.
7. Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense.

Q. Warranties

1. Specified materials and workmanship provided shall be fully guaranteed by the Contractor for one year from the transfer of title via notice of substantial completion against any defects in materials or workmanship.
2. Extended (additional) warranty(s) may be required and will be identified in the individual Specification Section and will be considered additive to this base Contractor Warranty.
3. Requirements for Manufacturer's Warranties, required by a Specification Section, shall run concurrent to this base Warranty by the Contractor but may exceed the Contractor's Warranty Period.
4. Manufacturer's Warranties shall also begin upon Substantial Completion.
5. The Warranty shall begin upon Substantial Completion.
6. This warranty shall in no manner cover equipment that has been damaged or rendered unserviceable due to negligence, misuse, acts of vandalism, or tampering by the Owner or anyone other than employees or agents of the Contractor.
7. The Contractor's obligation under its warranty is limited to the cost of repair of the warranted item or replacement thereof, at the Contractor's option.
8. Insurance covering said equipment from damage or loss is to be borne by the Contractor until full acceptance of equipment and services.
9. Individual specification sections may have additional warranty requirements for the work in that section. The warranty above will cover all materials and work where not covered by an extended warranty listed in the individual specification section.
10. Specified materials and workmanship provided shall be fully guaranteed by the Contractor against any defects in materials or workmanship.
11. Contractor shall provide a full "System Warranty" which shall cover all materials, labor and related product shipping expenses for a period of five years from the date of Owner acceptance.
12. Supplied products with manufacturer's warranties of less than the System Warranty term shall be extended by the Contractor for the full specified term.

13. During this period the Contractor will remedy (at no cost to the owner) any problem with the system, or any of its related components that is the result of defective materials, settings, workmanship, or loss or programming.
14. Any defective items or work shall be removed and replaced at the Contractor's expense to the satisfaction of the owner's representative and the Owner.
15. The period of the Contractor warranty(s) for any items herein are not exclusive remedies, and the Owner has recourse to any warranties of additional Scope given by the Contractor to the Owner and all other remedies available by law or in equity.
16. Additional Warranty requirements may be added by an individual Specification Section.
17. Scope of these extended (additional) warranty(s) will be identified in the individual Specification Section and will be considered additive to this base Contractor Warranty.
18. Requirements for Manufacturer's Warranties, required by a Specification Section, shall run concurrent to this base Contractor Warranty by the Contractor.
19. Manufacturer's Warranties shall also begin on Substantial Completion.

R. Demonstration and Training

1. Each Division 28 section may specify special Training requirements.
2. Training requirements will be for a quantity of hours, allow for multiple trips.
3. If no special requirements are specified in the individual section, provide for training and multiple trips for complete operation and maintenance information per section.
4. Train Owner's maintenance personnel on the procedures and schedules involved in operating, general troubleshooting, and preventative maintenance of the system.
5. Contractor shall require all attendees to sign-in for each training session. The sign-in form shall summarize the training to be conducted, specification section and subsection being trained on, as well as the starting time and duration of training. Following training, a representative of the owner shall sign the form, acknowledging the same. Contractor shall retain the original copy of these forms and turn over a photocopy of the form to the owner's representative as evidence of training. Training conducted without this official record of training shall not be considered as part of the Contractor's training obligation.
6. Schedule training with the Owner's representative, at least 14 days in advance.

PART 2 - PRODUCTS

2.1 ASSIGNMENT OF MISCELLANEOUS WORK

A. Excavating and backfilling for telecommunications work shall be by telecommunications contractor.

1. Properly support banks of excavation with safety sheet pile. Install necessary guards. Provide adequate pumping equipment and keep excavation free of water.
2. Excavate pipe trenches to proper depth. Where rock is encountered, excavate to 6 inches below pipe and refill to 6 inches above pipe with compacted granular fill. Granular fill shall consist of dune sand, gravel or other suitable material containing not more than 10 percent by weight passing #200 sieve and 100 percent passing 1-inch sieve.
3. Excavation for utilities shall not be backfilled until all required tests are performed and approved by Engineer and the utility company.

4. Whenever underground feeders are run below footings and grade beams, contractor shall backfill the void with poured, steel-reinforced concrete to elevation of bottom of footing or grade beam.
5. Backfill within building lines shall be made with granular fill or compacted backfill material laid in 6-inch layers and tamped to specified compaction after each layer.
6. Backfill under paved area shall be made with granular fill compacted backfill material laid in 12-inch layers and tamped to compaction after each layer.
7. Backfill under open yards or fields shall be made with non-compacted backfill laid in layers not to exceed 24 inches deep. Sand trenches may be allowed to settle naturally and shall be refilled back to grade as required during first year after final acceptance.
8. Contractor shall refill, regrade and refinish any area that becomes unsatisfactory due to settlement within one year after final acceptance.
9. Contractor shall verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to any trenching, excavation or underground installation. In event existing conditions are such as to prevent installation in accordance with Drawings, contractor shall immediately notify Engineer.
10. Provide appropriate plastic marker tape buried directly above underground electric and communication lines continuously along length of lines. Marker tape shall be located 12 inches below finished grade, but no closer than 12 inches above underground lines. Tape shall be a minimum of 6 inches wide.
11. Refer to Division 31 Section “Earth Moving,” for additional requirements. In event of conflict between this section and Division 31 Section “Earth Moving,” Division 31 Section “Earth Moving” shall apply, unless otherwise indicated by Engineer.

B. Provide sleeved penetrations for all cabling access where applicable.

1. Where conduits pass through walls, roofs, ceilings, or floors, contractor shall set sleeves when floors, walls, ceilings or roofs are constructed. If any holes are cut in finished work where sleeves have been omitted, cutting shall be done with a concrete coring machine or other approved means and only with consent of Engineer. All such holes are to be carefully cut and shall not be larger than necessary. These holes are to be entirely covered by escutcheon plates when work is completed. Sleeves shall be made of pipe or rolled sheet steel no lighter than No. 18 gauge.
2. Where conduits pass through sleeves in exterior walls above grade, annular space shall be caulked with oakum and filled inside and out with non-hardening, waterproof sealant finished off flush with both faces of wall.
3. Provide penetration seals for all conduits penetrating the building wall below grade.

    a. Description: The pipe to wall penetration closures shall be "Link-Seal" or equal, as manufactured by PSI/Thunderline Corporation – Houston, TX. Seals shall be modular type, consisting of synthetic rubber shaped to continuously fill the annular space between the pipe and wall opening. After the seal assembly is positioned in the sleeve, the rubber sealing elements shall provide an absolutely water-right seal between the pipe and wall opening. The seal shall be constructed as to provide insulation between the pipe and wall, thus reducing changes of cathodic reaction between these two members.
    b. Wall Opening: Provide “Century-Line” sleeves or equal as manufactured by PSI/Thunderline Corporation – Houston, TX. Contractor shall determine the required inside diameter of each individual wall opening of sleeve before ordering, fabricating or installing. The inside diameter of each wall opening shall be sized as

recommended by the manufacturer to fit the pipe and Link-Seal to assure a water-tight joint. Sizing (correct Link-Seal model and number of links per seal) may be obtained through manufacturer's catalog. If pipe O.D is non-standard due to coating, insulation, etc. consult Thunderline's factory for engineering assistance and recommendation before proceeding with wall opening detail.

c. Holes through Structural members: Holes required for conduit of size 5-inches and smaller shall be cut in field at expense of this contractor. Obtain structural engineer’s approval in writing prior to any cutting.

d. Pitch Pockets: Required for conduit penetrating roof. Seal sleeves and provide flashing.

e. Dust Protection: Provide temporary partitions or barriers required to protect existing building or facility. Coordinate necessity and location of such protection with Owner.

f. Painting of telecommunications cabling and components is not permitted. Notify painting contractor that painting of telecommunications cabling and components is not permitted. Protect cabling as necessary to avoid painting.

2.2 MATERIALS AND EQUIPMENT

A. Equipment shall be new, listed by UL and shall conform to NEMA and ICEA standards.

B. Materials used for like service shall be by same manufacturer.

C. All materials and equipment, including any hangers, supports, fastenings or accessory fittings, shall have corrosion protection suitable for atmosphere in which they are installed, whether located indoors or out. Care shall be taken during installation to assure integrity of corrosion protection.

D. All screws, bolts, nuts, clamps, fittings or other fastening devices shall be made up tight. All bolts, screws, nuts and other threaded devices shall have standard threads and heads so they may be installed and replaced when necessary without special tools.

2.3 PRODUCT AND MATERIAL APPROVAL

A. A Specification followed by one or more manufacturers is limited to those manufacturers. Names of other manufacturers may be submitted for approval to Engineer a minimum of ten (10) days prior to receiving bids. Approval will be issued by Addendum if granted.

B. A Specification followed by one or more manufacturers and "or approved equal" is open to all equal products or materials; however, Contractor shall supply one of listed manufacturers at no additional cost if Engineer finds substituted product unsatisfactory.

2.4 CAULKING AND FIRESTOPPING

A. In addition to the requirements in Division 07 Section “Penetration Firestopping,” comply with this Article.

B. All raceway and sleeve penetrations of fire barriers shall be sealed to achieve fire resistance equivalent to fire separation.

1. Maintain fire rating per ASTM E-814 and UL 1479.
2. This assembly must also maintain a watertight seal between floor or wall and pipe.

C. For other penetrations through non-rated walls, partitions, floors and ceilings, caulk the space between raceways and raceway sleeves with non-staining, waterproof gun grade compound. Apply caulking compound by the gun method using nozzles of a proper size to fit the width of joint. Prepare the joint for caulking by packing it tightly with a resilient foam or rope yarn.

D. Products: Subject to compliance with requirements, provide one of the following:

1. Maintain fire rating per ASTM E-814 and UL 1479.
2. Penetration sealant:

a. 3M Brand "Moldable Putty Pads": and "Moldable Putty Stix"
b. 3M Brand "Fire Barrier" Caulk, Putty or Penetrating Sealing Systems
c. Dow Corning "Fire Stop Foam: and "Fire Stop Sealant" systems
d. Insta-Foam Products, Inc. "Insta-Fire Seal Silicone RTV Foam"
e. Standard Oil Engineering Materials Company, "Frye Putty"
f. Chase technology "Chase Foam #CTC PR-855"

3. Intumescent Sealant for use at openings and sleeves involving flexible cable.

a. 3M Brand "Fire Barrier" caulk or putty, FS-195 Wrap Strip and CS-195 Composite Sheet.
b. Dow Corning "Fire Stop Intumescent Wrap Strip"
c. Fox Couplings, Inc. "The Fox Cast-in-Place Coupling"

4. Performance Characteristic: Firestopping materials shall conform to both Flame (F) and Temperature (T) ratings as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test.

a. ^{o}F Rating shall be a minimum of one hour but not less than the fire resistance rating of the assembly being penetrated.
b. Conduct the fire test with a minimum positive pressure differential of 0.01 inches of water column.

5. Quality Assurance: Installer qualifications – a firm specializing in firestopping installation with not less than two years of experience or trained and approved by firestopping manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION OF COMMUNICATIONS SYSTEMS

A. General

1. All work installed in finished areas shall be concealed.
2. Install systems, materials, and equipment to conform with approved documents.
3. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
4. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
5. Verify all dimensions by field measurements. Take measurements and be responsible for exact size and locations of all openings required for the installation of work. Proposed dimensions are reasonably accurate and should govern in setting out work. Where detailed method of installation is not indicated or where variations exist between described work and approved practice, direction of the owner's representative on job shall be followed.
6. Workmanship throughout shall conform to the standards of best practice. Marks, dents or finish scratches will not be permitted on any exposed materials, fixtures or fittings. Inside of panels and equipment boxes shall be left clean.
7. Use caution not to exceed the allowed bend radius for respective cables and not to compromise the integrity of the cables during installation by pulling cable management devices too tightly, damaging cables, etc. Raceway/Cabling bending radii shall be minimum as directed by cable manufacturer. Use pulling compound or lubricant, where necessary; compound must not deteriorate conductor or insulation.

B. Cable

1. Provide color-coded jackets to identify different systems.
2. Neatly comb out multiple cable bundled runs to remove tangling and crossing of cables within the bundles. Neatly dress all cable work and provide vertical and horizontal cable management (or other approved method) for properly dressing all work at racks, control panels, backboards etc.
3. Provide spacing between cable bundles to help dissipate heat. Do not cinch cables into tight bundles.
4. Nylon cable ties are not permitted. Bundle cables with “Velcro” style cable straps with a minimum of 1-inch width.
5. All cables shall be supported every 5 feet (or less) and within 12" of device boxes, outlets, racks/cabinets and cable tray.
6. Use separate J-Hook cable support systems for cables belonging to different systems and for cables carrying different operating levels.
7. Loosely secure cables at each J-Hook.
8. Cables shall not be directly or indirectly supported by a suspended ceiling or any other surface, support, material or structure not permissible for this use by all applicable codes and standards.
9. Cables carrying signals of different nominal operating level shall be kept separated to reduce the risk of undesirable cross-talk interference between cables.
10. Keep length of parallel runs to a minimum. Cross cables of different nominal levels at 90 degrees.
11. Provide additional separation as necessary to prevent and remedy any crosstalk.
12. Contractor shall take all precautions necessary to keep low-voltage cable away from sources of EMI and RF interference. Where close proximity is absolutely necessary to satisfactory appearance, performance or installation of the Work, provide all necessary

shielding necessary to ensure that ingress interference is minimal and has no negative impact of the Work.

13. Provide a minimum of 12 inches cable slack where terminating at a device outlet to facilitate installation and servicing of devices. Longer working lengths shall be provided as appropriate to the application.
14. All termination types shall correctly match the cable and device termination point. Connectors of the appropriate type, size, color and rating shall be used to match with the mating equipment.
15. Tools as recommended by each specific connector manufacturer shall be used in attachment of all connectors.
16. When spade connectors are the required to be used for audio circuits operating at <= +8dBv nominal, solder type spade connectors only shall be permitted.
17. No more than two spade connectors shall be permitted under a single terminal. Fewer should be used when recommended by the specific manufacturer's equipment or connector.
18. Wire Nuts

    a. Wire nuts shall not be used in any audio circuit, except when necessary in the following:

        1) 25 Voltage Constant-Voltage loudspeaker circuits.
        2) 70 Voltage Constant-Voltage loudspeaker circuits.

    b. Wire nuts shall not be used in any data or voice communications or remote-control circuit.
    c. Wire nuts shall not be used in any circuit which radiates RF energy.
    d. Contractor must advise and gain prior approval of the Owner for any circuit which the Contractor desires to use wirenuts as the means of termination.

19. Drain Wires, Non-insulated Ground Wires and Shields

    a. Drain or non-insulated ground conductors shall be insulated with appropriately sized heat-shrinkable insulated sleeving immediately upon exit from the jacket of the cable. Contractor shall use GREEN colored sleeving unless otherwise necessary to resolve specific color-coding conflicts on a given cable. This methodology shall apply to ALL methods of termination, including inline connectors, device plates, direct equipment terminations etc… Sleeving shall be applied to twisted and braided shields once the internal conductors have been combed out or otherwise removed from the center of the shield.
    b. Wherever a cable contains a non-insulated conductor within a jacketed cable, the conductors, as they exit the manufacturer's jacket, shall have a piece of heat shrinkable sleeving applied equally over the jacket and the exposed insulated conductors. The length of this sleeving shall be 1" for all cable diameters of .250" or less. For cables diameters larger then .250" the length of the sleeving shall be approximately equal to 4 times the diameter of the cable jacket. Note: This added sleeving is recommended but not mandatory when cable termination occurs fully within the confines of a fully insulated and strain relieved connector. Black shall be used unless otherwise necessary for specific cosmetic or cable identification purposes.
    c. A heat-gun of the appropriate temperature, size, type and rating for shrinking the tubing shall be used as recommended by the manufacturer of the sleeving used.

Open flame (i.e. matches, cigarette lighters, torches) and direct metal conduction (i.e. soldering iron) methods to shrink the sleeving shall not be permitted. Sleeving which is burnt or otherwise marred shall be removed and replaced.

d. There shall not be any non-insulated exposed conductors within a device backbox, junction box, or equipment rack/cabinet.

20. Unused Conductors

a. Unused conductors shall not be "clipped" or removed from any jacketed cable. Conductors which are not required or used at the end of a jacketed cable shall be kept intact. Conductors shall be fully insulated from one and other to prevent shorts which could occur at either end of the cable. Conductor ends shall also be insulated to prevent shorts to other conductive materials which could come in contact with the conductor.

b. Unused conductors shall be kept the same length as the longest conductor of the cable being used.

c. Attention shall be paid to the proper preparation of all cables and all conductors of these cables. There shall not be nicks to cable jackets, conductor insulation, or the conductors themselves.

d. Special attention should be paid to nicked conductors. Should a conductor be nicked during preparation or termination the cable shall be reworked/replaced to remove the nick.

e. Any voice, data, or coaxial cable that is cut, disconnected, or not terminated at both ends shall be completely removed end to end. Any labels at either end shall be erased. Record drawings shall reflect the removal of these cables.

3.2 ATTACHING TO BUILDING CONSTRUCTION

A. Attach supports to structural members (beams, joists, etc.) rather than to floor or roof slabs. Do not attach to ceiling support wires.

B. Where equipment and raceway are suspended from existing concrete or masonry construction, use expansion shields to attach supports to construction. Expansion shield bolt diameter shall be same size as support rod diameter, hereinafter specified. Expansion shields shall be Star Double, Star Gloxin, Star Loxin or approved equal.

C. Where existing masonry is not suitable to receive and hold expansion shield or where other means of attachment is advantageous, submit alternate method for approval by Engineer.

D. Equipment to be installed in groups shall not be mounted directly to masonry or concrete walls. Mount 1- by 1-inch structural channel such as Unistrut, to wall and secure equipment to these channels.

E. Where raceways are suspended from structural steel building framing or supporting members, provide beam clamps for attaching piping device to building member.

F. Obtain approval from Owner and structural engineer before cutting or welding to structural members, or before hanging heavy equipment.

3.3 ESCUTCHEONS

A. Provide chrome plated escutcheons on material, leaving and entering walls, floors, ceilings, etc.

3.4 EQUIPMENT INSTALLATION

A. All equipment must be installed such that maintenance and service may be properly accomplished. If necessary, the Owner, at their option, may require the contractor to demonstrate the service on any piece of equipment to determine sufficient service space exists. If the service space is not adequate, the equipment shall be relocated at no additional cost to the Owner such that sufficient service space is achieved.

3.5 OCCUPATIONAL SAFETY & HEALTH STANDARDS

A. All work shall comply with current requirements of U.S. Department of Labor-Occupational Safety & Health Administration, entitled Occupational Safety and Health Standards; National Consensus Standards and Established Federal Standards.

3.6 DEMOLITION

A. In addition to the requirements in Division 02 Section “Selective Demolition,” comply with this Article.

1. Scope of Work: Provide demolition required for removal of systems and equipment made obsolete by this Project and as determined by the Architect/Engineer.
2. Work Included:

a. Non-destructive removal of systems, materials, and equipment for reuse or salvage as shown on Drawings or requested by Owner.
b. Removal of all debris from site and legal disposal of same.
c. Removal of all abandoned or obsolete exposed materials and equipment for a clean and finished installation.
d. Removal of all abandoned or obsolete raceways, wiring, cabling, or electrical devices of any kind.

B. Conditions

1. Coordination: Adjacent areas need to remain in operation and services to these areas need to be maintained. A schedule will be worked out prior to beginning work and as many criteria for operation as possible will be explained. Contractor cooperation shall be expected in all conditions.
2. Phasing:

a. Prior to commencing demolition in any area of the work, notify the Owner and Architect/Engineer five (5) working days in advance to insure that no adjacent occupied areas will be disrupted.

b. Demolition phasing must be approved by Architect/Engineer prior to commencement of operations.
c. Removal of debris and construction traffic will be limited to specified areas. Confirm all operations with Architect/Engineer prior to commencement of work.

3. Adjacent Materials:

a. During the execution of the work, primary consideration shall be given to protecting from damaging the structure, furnishings, finishes, and the like which are not specifically indicated to be removed and disposed.
b. Provide and maintain temporary partitions or dust barriers adequate to keep dirt, dust, noise and other particles from being transferred to adjacent areas.
c. Existing items or surfaces to remain which are damaged as a result of this work shall be refinished, repaired, or replaced to the satisfaction of the Architect/Engineer and Owner at no additional cost.

C. Materials

1. Patching: Materials used for patching shall be in conformance with the applicable sections of the Project Manual. Where materials are not specifically described but required for proper completion of the work, they shall be as selected by the Contractor subject to approval of the Architect/Engineer. Materials used and workmanship shall match surrounding areas as much as possible, unless otherwise directed.

D. Demolition

1. Site Inspection

a. The Contract Documents do not propose to show all systems, materials, or equipment existing on the project that will require demolition.
b. Before commencing the work of this Section, verify with the Architect/Engineer and Owner all systems, materials, and equipment to be removed and those to be preserved.

2. Scheduling

a. Schedule all work in a careful manner with all necessary considerations for public and adjacent areas.
b. Avoid interference with the use of adjacent areas and passage to and from these areas.

3. Abandoned Materials and Equipment: Items so indicated on Contract Documents to be removed and not indicated or specified to be saved or retained, shall be demolished, removed, demounted, or disconnected in the best possible manner to ensure that no damage will result to other adjacent items or surfaces to remain.
4. Salvage

a. During removal of items so indicated, caution shall be used to eliminate damage to any equipment having salvage value.

b. All reusable salvaged material shall remain the property of the Owner and be retained for his inspection. Only items so inspected and rejected by the Owner shall be disposed by the Contractor. All other such items shall be turned over and deposited as directed by the Owner.

5. Disposal and Clean Up

a. Areas in which demolition and salvage work is being done shall be cleaned daily.
b. Dirt, dust, debris, unsalvageable and reusable items, and the like shall be totally removed from the project site daily. Under no circumstances shall such refuse be allowed to collect for longer periods.
c. Refuse shall not be allowed to block, or otherwise impair, circulation in corridors, stairs, sidewalks, or other traffic areas.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Integrated Intrusion Detection System (IDS).

B. The system shall monitor and provide notification of unauthorized building entry. The system shall provide email and/or text message alerts for all alarm conditions and threats.

C. The system includes but not limited to the following:

1. Software
2. Firmware
3. Control Panels
4. Intrusion Detection Sensors
5. Wiring
6. DSC 832 integration

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including:

1. Drawings:

a. Division 27 and 28 drawings.

2. Related Specification Sections:

a. Division 27 and 28 specifications.

1.3 CONTRACTOR REQUIERMENTS

A. The Contractor shall have a supporting office within (75) miles of the project location

B. Certifications: Technicians from the supporting office shall hold current certifications with the manufacturer

C. On-site maintenance and repair service shall be available locally and within (4) hours of notification of condition.

D. On-site Contractor personnel shall hold all required local, state, and federal licenses

E. On-site Contractor personnel shall hold current certifications with the manufacturer

1.4 QUALITY ASSURANCE

A. Installation shall comply with federal, state, and local codes and Authority Having Jurisdiction (AHJ).

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Install and program all software and hardware in accordance with manufacturer's specifications.

D. All equipment shall be new, in current production, and the standard products of a manufacturer of ESS equipment.

E. Manufacturer shall guarantee availability of parts, for a minimum of (7) years from date of shipment.

F. On-site maintenance and repair service shall be available locally and within (4) hours of notification of condition.

G. Contractor shall review drawings and specifications.

H. Test and certify all software integration between all integrated systems for interoperability by the manufacturer of each system.

1.5 PERMITS

A. All permits required for the specified performance and completion of the work shall be secured by the Contractor.

1.6 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to service, repair or replace system components as needed for proper system operation as specified herein.

B. Warranty Period: a 2-year warranty on hardware and a 1-year warranty on labor and software from date of date of Owner Acceptance.

PART 2 - PRODUCTS

2.1 GENERAL

A. Contractor Responsibility

1. All products not provided by the Owner shall be new and unused and shall be of manufacturer's current and standard production. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer. Drawings and Specifications indicate major system components, and may not show every

component, connector, module, or accessory that may be required to support the operation specified. The Contractor shall provide all components needed for complete and satisfactory operation.

2. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.

3. Certain products specified may only be available through factory-authorized dealers and distributors. Contractor shall verify his ability to procure the products specified prior to submitting a proposal.

2.2 FUNCTIONAL REQUIREMENTS

A. Intrusion Detection

1. Bosch Remote Programming Software (RPS), a Windows-based account management and control panel programming utility is required. It should be installed before you add panels to the EAC.
2. Requires Bosch B or G Series control panels running with firmware version 3.03.014 or later.
3. The license for the Bosch panel integration must be enabled in the EAC software. In addition to the integration license, you must obtain a separate Bosch Panel license for each panel that will be connected to the EAC controller
4. Provide complete configuration of EAC/Intrusion Detection integration.
5. Control Panel

    a. Provides points to accommodate as shown on the Drawings.
    b. On-board Ethernet port.
    c. Integrates with EAC
    d. Provide Bosch B450 series or approved equal.
    e. In addition, provide Bosch B920 2-line Alpha Numeric Keypad (SD12) or approved equal where indicated.

6. Sensor

    a. TriTech. Passive infrared and microwave Doppler radar detection with First Step Processing.
    b. Cloak and Camouflage Detection Technology.
    c. Provide Bosch ISC-CDL1-W15G Motion detector or approved equal.

7. The system shall integrate with the following intrusion panels:

    a. The new system shall integrate with the existing DSC 832 intrusion panel and control certain panel functionality, such as arming and disarming functions. The new addition and the existing building shall exist as two zones allowing arming and disarming of each zone independently as well as both zones simultaneously.
    b. Provide complete configuration of Intrusion Detection integration.

B. Videophone Entry System

1. Provide Aiphone AX-084C Central Exchange or approved equal in the IT Room 121.
2. Provide Aiphone AX-DV Video Door Station or approved equal where indicated at the main entrance.
3. Provide Aiphone AX-8MV Audio/Video Master or approved equal where indicated at the Reception desk. Master station shall provide programmable buttons to lockdown all entrances and allow entrance access by visitors.

C. Uninterruptible P0wer Supply (UPS)

1. Provide true online UPS system for back-up power for all central components in case of power interruption, brown-out, or fluctuations for a minimum of 30 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine cable pathways including conduit, raceways, cable trays, and other pathway elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine rough-in for control cable and conduit systems to controllers, card readers, and other system components to verify conduit and back-box locations prior to installation of system devices

C. Examine available network capacity and support infrastructure. Consult with network administrator for compliance with network standards and capacity

D. Examine install location for compliance with space allocations, installation tolerance, hazards to safe system operation, and other conditions affecting installation

E. Examine roughing-in for LAN, WAN, and IP network before device installation

3.2 PREPARATION

A. Comply with SIA CP-01 Control Panel Standard.

B. Comply with ANSI/TIA-606-B Labelling Standard.

C. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final programming and configuration documents. Use final documents to program and configure software.

3.3 WIRE AND CABLE

A. Comply with NECA 1, "Good Workmanship in Electrical Construction".

B. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

C. Install LAN cables using techniques, practices, and methods that are consistent with Category 6A rating of components and fiber-optic rating of components, and that ensure Category 6A performance of completed and linked signal paths, end to end.

D. Junction boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with tamper resistant fasteners and/or tamper detection switches. In addition, hinged enclosure doors shall be equipped with locking hardware. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

E. Keypads and Peripheral Devices:

1. Install number of conductor pairs recommended by device manufacturer for the functions specified.
2. Follow device manufacturer’s installation requirements for maximum cable distances and sizes.

3.4 IDENTIFICATION

A. Label, in plain English, each end of each cable, Field Panel, patch panel, network switch, or cabinet

1. Each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the device as shown

B. At completion, cable and asset management documentation shall reflect as-built conditions.

3.5 SYSTEM SOFTWARE AND HARDWARE

A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved.

B. Assign the software license(s) to Owner.

C. All default password shall be changed to those selected by the owner

1. The contractor shall retain no records of passwords for the project

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspection: Confirm that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
2. Pretesting: Configure and pretest system components, wiring, and functions to confirm that they comply with specified requirements.
3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements.
4. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
5. Operational Tests: Perform operational system tests to confirm that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

B. The system is considered defective and the project incomplete if it does not pass tests and inspections

C. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.

B. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

3.8 ADJUSTMENTS

A. Occupancy Adjustments: When requested within 30 days of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections
2. Confirm system configuration and adjust settings needed
3. Recommend changes to the system to improve Owner's use
4. Provide a written report of adjustments and recommendations

3.9 DEMONSTRATION

A. The training of all personnel shall be performed on-site by a manufacturer-certified trainer.

B. Provide a training tutorial and all handout material.

C. Provide a minimum of 8 hours training

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Camera Assemblies (camera, lens, housing, mount, etc.)
2. PoE Injector where required
3. Existing Network Video Recorder
4. Complete System configuration
5. Complete System testing
6. Camera labeling

B. System Connection Wiring

1. ANSI/TIA 568 Category 6A Compliant horizontal structured cabling system with a fiber backbone is provided. Connect system components to this cabling system utilizing Category 6A Compliant patch cables.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code - current version

1.3 SYSTEM DESCRIPTION

A. The system includes IP-based video surveillance cameras strategically placed for optimal viewing, video recording, and management of video images.

B. Design Requirements

1. Contractor Design

a. The Project Drawings represent the level of system design provided. Contractor shall provide all additional system design work required, including:

1) Wire and cable layout and sizing where not provided by others.
2) Equipment hook- up information.
3) Equipment mounting details.
4) Design of equipment racks/cabinets/enclosures.
5) Other detailed design work required.

b. Contractor’s design shall conform to all applicable codes and ordinances. All electrical design, including the sizing and placement of conduit, raceways and conductors, shall be in accordance with NFPA 70: National Electrical Code unless local codes establish more stringent requirements.

c. Contractor's design work is subject to review and approval by Owner's Project Manager.
d. Miscellaneous

1) Provide wire, cable, conduit, connectors and junction boxes required for system operation where not provided by others.
2) Provide complete testing of all wiring and cables prior to connecting to any equipment or power.
3) Other Work as defined within the Project Drawings and Specifications.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Contractor shall perform Work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents. Contractor shall maintain one set of complete instructions at the job site during installation and until completion.

C. Comply with the following as applicable:

1. NECA 1
2. NFPA 70
3. UL 294, UL 1076, ULC
4. CE
5. F IEEE, RS 170 variable standard
6. IEEE, NTSC (color camera broadcast)
7. Microsoft® Open Database Connectivity (ODBC) interface)
8. ISO Software Coding Standards for C++ and C##
9. RoHS CC – Part 15, Part 68

D. Electronic data exchange between video surveillance system with an access control system shall comply with SIA TVAC.

E. Qualifications

1. Qualifications of Contractor

a. Contractor shall be an installation and service contractor regularly engaged in the sale, installation, maintenance and service of video surveillance systems.
b. Contractor shall have five (5) years' experience with the installation, start- up and programming of systems of a similar size and complexity to the one proposed.
c. Contractor shall be a factory authorized dealer of the system proposed.
d. The Contractor shall maintain an office within fifty (75) miles of the construction site.
e. The Contractor shall have factory-certified technicians on-site.

2. Supervision or Work

a. Contractor shall employ a competent Foreman to be in responsible charge of the Work. Foreman shall be on the project site daily during the execution of the Work.
b. Contractor's Foreman shall be a regular employee, principle, or officer of Contractor, who is thoroughly experienced in projects of a similar size and type. Contractor shall not use contract employees or Subcontractors as Foremen.

3. Qualifications of Technicians

a. All electronic systems Work shall be performed by electronic technicians thoroughly trained in the installation and service of specialty low- voltage electronic systems.
b. Journeyman Wireman electrical workers may be used to install conduit, raceways, wiring, and the like, provided that final termination, hook-up, programming, and testing is performed by a qualified electronic technician, and that all such Work is supervised by the Contractor's Foreman.
c. All incidental Work, such as cutting and patching, hardware installation, painting, carpentry, and the like, shall be accomplished by skilled crafts persons regularly engaged in such type of work. All such Work shall comply with the highest standards applicable to that respective industry or craft.

F. Contractor shall perform Work in accordance with manufacturer's instructions. Do no omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents. Contractor shall maintain one set of complete instructions at the job site during installation and until completion.

G. Permits: The Contractor shall make application for and obtain any and all permits required by federal, state, county, city, or other authority having jurisdiction over the work.

H. Certifications: The system shall use U.L. Listed power supplies and lightning protection.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery to Job Site: Contractor shall have total responsibility for safe and secure delivery of security equipment and tools to the job site. Arrange deliveries of Products in accord with construction schedules to avoid conflict.

B. Storage and Protection: Owner is not responsible for the care, storage or security of any of the Contractor's tools or equipment.

1.6 PROJECT / SITE CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for

continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosures.

3. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 3R enclosures.
4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick. NEMA 250, Type 3 enclosures.
5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
6. Corrosive Environment: System components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. NEMA 250, Type 4X enclosures.
7. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.7 SEQUENCING

A. Description: This implementation plan describes the general approach that shall be followed in order to minimize the time for the video surveillance system to be operational.

B. Approach: Contractor shall plan and schedule all work in such a sequence as to minimize the time before the system is operational. The following is a suggested work sequence:

1. Order all equipment needed and notify any subcontractors to schedule their participation.
2. Perform all system layout work.
3. Insure there are an adequate number of power receptacles available to operate all security equipment and coordinate with Owner as to where power is available.
4. Provide shop drawings to verify location of all equipment, conduit runs, power connections, etc. Submit shop drawings to Owner Project Manager.
5. Coordinate with Owner to provide space for the placement of all monitoring, control and recording equipment.
6. Prepare and pre-test all equipment to the greatest extent possible.
7. Install all equipment.
8. Test and inspect all systems.
9. Perform all other Work as required.
10. Provide as-built drawings.
11. Perform the Acceptance Test.
12. Provide training.

1.8 SCHEDULING

A. The Contractor, within five (5) working days after being awarded the contract, shall prepare and submit for Owner’s information, an estimated progress schedule for the Work. The progress schedule shall be related to the entire project, and shall indicate start and completion dates.

1.9 WARRANTY

A. Contractor warrants that all Work furnished (material and labor) under this Contract will be of good quality, free from faults and defects, and in conformance with the Project Drawings and Specifications.

B. Contractor shall provide parts and labor guarantee on all Work. Unless otherwise specified herein, Contractor's guarantee shall be for a period of two (2) years from date of Acceptance, except where any specific guarantees from a supplier or equipment manufacturer extends for a longer time.

C. Contractor's guarantee shall cover all costs associated with troubleshooting, repair, and replacement of defective Work, including costs of labor, transportation, lodging, materials, and equipment.

D. Guarantee shall not cover any damage to material or equipment caused by accident, misuse, unauthorized modification or repair by Owner, or acts of god.

E. Contractor shall promptly respond to Owner's requests for service during the guarantee period. Contractor shall provide repair service as soon as reasonably possible upon request from Owner, but in no case shall service response exceed 8 hours from time of request.

1.10 SYSTEM STARTUP

A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds, and open circuits.

1.11 OWNER'S INSTRUCTIONS

A. Coordination with Owner

1. Contractor shall closely schedule and coordinate his activities with designated Owner representatives. Contractor shall provide Owner's Project Manager with a work plan on a weekly basis. Such work plan will describe locations of intended activities, types of activities, and potential conflicts to facility operations.

B. Coordination with Manufacturer

1. Contractor shall perform Work in accordance with manufacturer's instructions. Do no omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents. Contractor shall maintain one set of complete instructions at the job site during installation and until completion.

1.12 COMMISSIONING

A. After all Work is completed, and prior to requesting the Acceptance test, Contractor shall conduct a final inspection, and pre-test all equipment and system features. Contractor shall correct any deficiencies discovered as the result of the inspection and pre-test.

B. Contractor shall submit a request for the Acceptance test in writing to the Owner Project Manager, no less than fourteen days prior to the requested test date. The request for Acceptance test shall be accompanied by a certification from Contractor that all Work is complete and has been pre-tested, and that all corrections have been made.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Approved Manufacturers:

1. Central Control and Management System (NVR)

   a. Existing Honeywell HEN16284

2. Cameras

   a. As supported by Central Control Management system.
   b. Include PoE Injector when recommended by manufacturer.

2.2 GENERAL

A. Contractor Responsibility

1. All products not provided by Owner shall be new and unused and shall be of manufacturer's current and standard production. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.

2.3 SYSTEM REQUIREMENTS

A. Design Requirements

1. Contractor Design

   a. The Project Drawings represent the level of system design to be provided. Contractor shall provide all additional system design work required, including:

      1) Point-to-point wiring and equipment hook- up information.
      2) Equipment mounting details.
      3) Other detailed design work required.

b. Contractor's design shall conform to all applicable codes and ordinances. All electrical design, including the sizing and placement of conduit, raceways and conductors, shall be in accordance with NFPA 70: National Electrical Code unless local codes establish more stringent requirements.
c. Contractor's design work is subject to review and approval by the Architect.
d. Miscellaneous

1) Provide all connectivity required for system operation.
2) Provide complete testing of all wiring and cables prior to connecting to any equipment or power.

B. All products shall be new and unused and shall be of manufacturer's current and standard production. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.

2.4 PRODUCT AVAILABILITY

A. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.

B. Certain products specified may only be available through factory-authorized dealers and distributors. Contractor shall verify his ability to procure the products specified prior to submitting a proposal.

C. Conduit and Raceway Systems

1. Currently being installed under a separate Contract.

D. Lightning Protection

1. The Contractor shall provide suitable lightning protection for all equipment.
2. All lightning protection equipment shall be UL listed.

2.5 CENTRAL SYSTEM HARDWARE

A. The system shall support hardware provided either by the system manufacturer or by a third-party manufacturer. Third-party hardware shall be manufacturer independent, and shall meet the minimum specifications.

B. Central Control and Management System (NVR)

1. Existing Honeywell HEN16284.
2. Provide increased storage to accommodate the additional sensors as recommended by the manufacturer.

2.6 CAMERAS

A. Exterior Camera:

1. The power source shall be Power over Ethernet (PoE).
2. Provide PoE integrated heater
3. Provide intelligent motion detection
4. Provide camera housings and pendant-mount professionally painted to match building surface
5. Provide Hanwha PNM-9084RQZ1 where indicated or approved equal.

2.7 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide true online UPS system for back-up power for system components in case of power interruption, brown-out, or fluctuations for a minimum of 30 minutes.

2.8 SIGNAL TRANSMISSION COMPONENTS

A. ANSI/TIA 568 Category 6A Compliant horizontal structured cabling system with a fiber backbone is provided. Connect system components to this cabling system utilizing Category 6A Compliant patch cables.

PART 3 - EXECUTION

3.1 PREPARATION

A. The Contractor shall order all required parts and equipment upon notification of award of the Work.

B. The Contractor shall bench test all equipment prior to delivery to the job site.

C. The Contractor shall verify the availability of power where required. If a new source of power is required, a licensed electrician shall be used to install it.

D. The Contractor shall arrange for obtaining all programming information prior to bringing the system to the project site.

3.2 INSTALLATION

A. General

1. The Contractor shall coordinate with the Owner’s Project Manager for storage of the equipment in a secured location prior to installation.
2. The Contractor shall carefully follow the instructions in the manufacturers’ Installation Manual to ensure all steps have been taken to provide a reliable, easy to operate system.

3. The Contractor shall coordinate with the Owner's facilities coordinator to insure the proper location to tap into electrical power.
4. Perform all Work as indicated in the Drawings and Specifications.
5. The Contractor shall install the appropriate cables from the cameras to the monitoring and recording equipment.
6. All communications cables shall be kept away from power circuits.
7. The Contractor shall also execute adequate testing of the system to insure proper operation.
8. The Contractor shall provide adequate training of the system users to insure adequate understanding to prevent operating errors.

B. Recording Format

1. Set all cameras to record MJPEG at 15 IPS, 4CIF.
2. System shall retain a minimum of two weeks recorded content.
3. Set all cameras to record on motion at approximately 25%.

C. Workmanship

1. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
2. Perform Work with persons experienced and qualified to produce workmanship specified.
3. Maintain quality control over suppliers and Subcontractors.
4. Quality of workmanship is considered important. Owner Project Manager shall have the authority to reject Work that does not conform to the Drawings and Specifications.

D. Equipment Pre-Test

1. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench test per manufacturers' installation instructions.

E. Wire and Cable

1. Connect system components complete as indicated.

F. Wire and Cable Terminations

1. Identify all inputs and outputs on terminal strips with printed labels.
2. Neatly dress and tie all wiring. The length of conductors within enclosures shall be sufficient to neatly train the conductor to the terminal point with no excess. Run all wire and cable parallel or normal to walls, floors and ground.
3. Install connectors as required by equipment manufacturers.
4. Terminations shall be made so that there is no bare conductor at the terminal. The conductor insulation shall bear against the terminal or connector shoulder.
5. Do not obstruct equipment controls or indicators with wire or cable. Route wire and cable away from heat producing components such as resistors, regulators, and the like.

G. Conduit and Raceway

1. Design, lay-out, size and plan new conduit and raceway systems as required. Provide sleeved penetrations at all barriers.

H. Indoor Requirements

1. Route exposed conduit and raceway parallel and perpendicular to walls and adjacent piping.
2. Maintain minimum a six (6) inch clearance between conduit and piping.
3. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps.
4. Use conduit bodies to make sharp changes in direction, as around beams. Fasten conduits and raceways to structural steel using approved spring clips or clamps.
5. Where conduit penetrates fire-rated walls and floors, seal opening with UL listed fire rated sealer or other methods as approved by codes.
6. No exposed conduit, raceway, or junction box shall be installed within any office area.
7. Install all boxes straight and plumb.
8. Do not support conduit from mechanical, plumbing, or fire sprinkler systems.
9. Drill or core drill all holes in walls, ceilings, or floors where required for new conduits. Do not cause damage to any structural steel or other structural support member by drilling or cutting.
10. Do not use flexible conduit in lengths longer than six (6) feet.

I. Outdoor Requirements

1. Where conduit penetrates exterior walls, seal opening around conduit in an approved manner to make watertight.
2. Use galvanized straps and fasteners on all exterior conduit.
3. All exterior boxes will only be used to aid in pulling the cable between points.

J. Penetrations

1. Do not penetrate any roof, flashing, exterior wall, or parapet without prior approval from Owner’s designated Construction Project representative.

K. Grounding

1. Provide earth grounding of equipment as required by equipment manufacturer. Earth ground shall be connected to ground rod or approved cold water pipe. Electrical or telephone ground connections shall not be used as earth grounds. Connections to mounting posts or building structural steel shall not be used as earth grounds.

L. Power to Security Equipment

1. Power all equipment from 120 VAC circuit dedicated for security use, except as noted. Mark all panel circuit breakers with labels worded “Security Equipment - Do Not Operate”, or equivalent.
2. All plug- in transformers shall be located at the security control panels. Secure all low-voltage plug- in transformers to outlet with screw or strap. Clearly label all transformers to identify purpose and use.

M. Cutting and Patching

1. The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work.

N. Painting

1. All conduit, fittings, and junction boxes shall be painted to match the existing surfaces they are mounted on.

O. Labeling

1. Label all cameras as coordinated and discussed with the Owner/engineer.

3.3 FIELD QUALITY CONTROL

A. Final Tests and Inspection

1. The Contractor shall coordinate with the Owner's Project Manager for final tests and inspections in the presence of the Project Manager, System Designer/Consultant, and a factory support person from the manufacturer.

B. Training

1. The training of all personnel shall be performed on-site by a manufacturer-certified trainer.
2. Provide a training tutorial and all handout material.
3. Provide a minimum of 8 hours training.

END OF SECTION

PAGE LEFT BLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Nonsystem smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.
10. Network/GSM Communicator.
11. Fire alarm wire and cable.
12. Surge protective devices.
13. Identification products.

1.2 SYSTEM DESCRIPTION

A. Noncoded, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Submit simultaneously with Shop Drawings.

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:

1. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified fire-alarm technician, Level III minimum.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

a. Frequency of testing of installed components.
b. Frequency of inspection of installed components.
c. Requirements and recommendations related to results of maintenance.
d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by the manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Edwards Signaling; a Carrier Company.
2. GAMEWELL; a Honeywell company.
3. NOTIFIER; a Honeywell company.
4. Siemens Building Technologies, Inc.; Fire Safety Division.
5. Silent Knight; a Honeywell company.
6. SimplexGrinnell LP; a Tyco International company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Automatic sprinkler system water flow.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm-notification appliances.
2. Identify alarm at the fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

    a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

    a. Install no more than 50 addressable devices on each signaling line circuit.

D. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

E. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

F. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid.

G. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. Provide surface mounted devices with manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
4. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

2.6 NONSYSTEM SMOKE DETECTORS

A. Single-Station Smoke Detectors:

1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.
2. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.
3. Visible Notification Appliance: 177-cd strobe.
4. Heat sensor, 135 deg F combination rate-of-rise and fixed temperature.
5. Test Switch: Push to test; simulates smoke at rated obscuration.
6. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
7. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
8. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
9. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

B. Single-Station Duct Smoke Detectors:

1. Comply with UL 268A; operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated and with screw terminals for system connections. Boxes shall be mounted on recessed outlet box. Provide surface mounted devices with manufacturer's surface back box.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

D. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall and ceiling mounted as indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate:

a. Wall Mounted: Factory finished, red.
b. Ceiling Mounted: Factory finished, white.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Zone of the supervisory signal.
3. Zone of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

G. The communicator shall connect directly to the primary analog UL listed fire alarm control panel telephone ports.

H. Communicator shall communicate to GSM networks in the area including 2G, 3G, and 4G. Multi-GSM platform technology automatically detects and chooses the best network in the area based

on signal strength and immediately self-adjusts for operation.

I. Supports dynamic (DHCP) and public and private static IP addressing.

J. Communicates over any type of customer-provided Ethernet 10/100 Base network connection (LAN or WAN), DSL modem or cable modem.

K. Data transmits over SIA DC-05 standard contact-ID protocol is secured with 256-bit symmetric key Advanced Encryption Standard (AES.)

L. Three field selectable reporting paths:

1. Cellular only.
2. IP only.
3. IP primary; cellular backup.

M. Diagnostic LEDs: Signal strength and status indications.

N. IP and GSM shall be self-tested everyday

O. Circuits shall be power-limited.

P. Comply with UL864.

Q. Communicator shall be connected to fire alarm control panel DACT telephone ports and shall transmit contact ID formatted alarms, supervisory or troubles to a remote central monitoring station receiver via Ethernet over a private or public WAN/LAN, Intranet or Ethernet.

R. Communicator shall include connections to the fire alarm control panel outputs and shall convert the contact ID protocol into Ethernet packets.

S. Communication shall include:

1. Independent zone (alarm, trouble, non-alarm, supervisory)
2. Independent addressable device status
3. Main (ac) power loss
4. Low battery and ground (earth) fault
5. System off normal
6. 24-hour test signal
7. Abnormal test signal (per UL requirements)

T. Communicator shall support independent zone reporting via the contact ID format. This format shall enable the central station to have details concerning the location of the fire for emergency response. Communicator shall provide simulated phone lines to the fire alarm control panel. Communicator shall communicate over IP or GSM primary and shall be transparent to the fire alarm control panel normal operation over phone lines.

U. Communicator shall be housed in a UL-listed cabinet with steel back box and door with provisions for electrical conduit connections into the sides and top.

V. The main power supply shall operate on 120 V ac, 60 Hz, 0.50 amp, and shall provide all necessary power for the communicator.

W. Positive-temperature-coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on power outputs. The power supply shall be provided with an integral battery charger.

X. The main power supply shall continuously monitor field wires for ground (earth) fault conditions.

Y. Upon loss of primary (ac) power to the communicator, the battery shall have sufficient capacity to power the communicator for 24 hours standby time followed by 5 minutes of alarm.

Z. The battery shall be completely maintenance free.

2.12 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer, but not less than No. 18 AWG.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Circuits less than 100 volts: No. 16 AWG, minimum.
2. Circuits more than 100 volts: No. 12 AWG, minimum.

2.13 SURGE PROTECTIVE DEVICES

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

a. DITEK Largo, FL, USA

B. 120-Volt Power Circuits

1. Furnish and install Surge Protective Devices (SPDs) on all nominal 120VAC electrical circuits that supply power to a Fire Alarm Control Panel.
2. SPD shall be Recognized or Listed to UL 1449 Fourth Edition, Surge Protective Devices.
3. SPD shall be Recognized or Listed to UL 1283, EMI/RFI Filtering.
4. SPD shall incorporate a series-wired design.

5. SPD shall incorporate both an LED diagnostic status indicator, and a Form C contact terminal block for remote notification of protection status.
6. The SCCR (short circuit current rating) of the SPD shall be equal to, or greater than, the AIC rating of the circuit breaker it is being fed from per NFPA 70, National Electrical Code, Article 285.6
7. The SPD shall have a minimum Nominal Discharge Current *(I_n)* of 3 kA.
8. The SPD shall provide all modes of protection based on the system voltage.
9. The Voltage Protection Rating (VPRs) for each mode shall not exceed the following:

    a. Line to Neutral (L-N): 600V
    b. Line to Ground (L-G): 600V
    c. Neutral to Ground (N-G): 500V

10. SPD shall be self-restoring and fully automatic.
11. Total Surge Current Rating shall be a minimum of 50 kA.
12. Maximum Operating Current shall be at least 20 Amps.
13. The SPD enclosure shall be rated NEMA 12 (minimum) for indoor dry locations and NEMA 4X (minimum) for outdoor, wet, damp, chemical, or corrosive areas.

C. Communications Circuits

1. Furnish and install Surge Protective Devices (SPDs) on all telephone communication circuits, Ethernet circuits, or external wireless antenna cables that wire directly into the Fire Alarm Control Panel or a separate Communication Panel.
2. SPD for telephone circuits shall be listed to UL 497A, Secondary Protectors for Communications Circuits.
3. SPD for Ethernet circuits and wireless antenna cables shall be listed to UL 497B, Protectors for Data Communications and Fire Alarm Circuits.
4. SPD shall incorporate a series-wired design.
5. Total Surge Current Rating shall be a minimum of 1 kA.

D. Data and Signaling System Circuits

1. Furnish and install Surge Protective Devices (SPDs) on all metallic data and signaling system circuits that leave the building per NFPA 72, National Fire Alarm and Signaling Code, Chapter 12 and NFPA 70, National Electrical Code, Article 760.32. These circuits include, but are not limited to, Signaling Line Circuit (SLC), Post Indicator Valve (PIV) monitoring circuit and Notification Appliance Circuit (NAC).
2. SPD shall be listed to UL 497B, Protectors for Data Communications and Fire Alarm Circuits.
3. SPD shall incorporate a series-wired design.
4. SPD shall incorporate a multi-stage, hybrid design that utilizes at least two (2) different types of surge protection technology.
5. Total Surge Current Rating shall be a minimum of 20 kA.
6. Maximum Operating Current shall be at least 5 Amps for NAC/PIV Surge Protective Device.
7. Maximum Operating Current shall be at least 1 Amp for SLC Surge Protective Device.

2.14 IDENTIFICATION PRODUCTS

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

1. Brady Corporation
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.

C. Connecting to Existing Equipment: Verify that the existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

D. Smoke- or Heat-Detector Spacing:

1. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
2. Lighting Fixtures: Locate detectors no closer than 12 inches from any part of a lighting fixture.

E. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

G. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

K. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

3.3 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces where unenclosed wiring method may be used. Conceal raceway except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.4 SURGE PROTECTIVE DEVICE INSTALLATION

A. Install Surge Protective Devices in accordance with manufacturer's installation instructions.

B. The conductor wire length between the SPD and the equipment being protected shall be a minimum of 3 feet in length. The conductor wire length can be greater than 3 feet as long as they are isolated and are not subjected or directly exposed to internally- or externally-generated transient voltage spikes and/or surges.

C. A standard multi-position grounding bus bar shall be used when terminating SPD ground wires to existing electrical grounding conductors. Twist-on wire connectors will not be accepted.

D. When multiple SPDs are used, a dedicated ground wire shall be run from each individual SPD directly to a multi-position grounding bus bar. "Daisy-chaining" multiple SPD ground wires together via the SPD grounding terminals will not be accepted.

E. The field wiring (unprotected wires) and the protected wiring shall occupy separate conduit feeds when entering and leaving the SPD enclosure.

F. SPD's shall not be mounted inside of the Fire Alarm Control Panel.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION

PAGE LEFT BLANK