Agreement for Construction Services

(Choice Partners Cooperative Contract #CSP-22-049MF)

This Agreement ("Agreement") between Williamson County, Texas, a political subdivision of the State of Texas ("Owner") and The Brandt Companies, LLC ("Contractor") is entered into in accordance with the following terms and conditions:

ARTICLE 1 SCOPE OF WORK: The Owner desires to retain Contractor for the construction of Jail North Dishwasher Exhaust (hereinafter called the "Project"). The Contractor shall have the overall responsibility for and shall provide complete construction services and furnish all materials, equipment, tools and labor as necessary or reasonably inferable to complete the Project, or any phase of the Project, in accordance with the Owner's requirements and the terms of this Agreement (hereinafter collectively referred to as the "Work").

ARTICLE 2 CONTRACT PRICE: Owner agrees to pay to the Contractor, for the satisfactory performance of the Work, the sum of **One Hundred Sixteen Thousand Four Hundred Eighty-One and No/100 Dollars ($116,481.00)** in accordance with the terms and conditions of this Agreement.

ARTICLE 3 PLANS AND SPECIFICATIONS: The Work shall be performed pursuant to and in accordance with the plans and specifications attached hereto as **Exhibit "A"**, as well as any revisions made thereto.

ARTICLE 4 CONTRACT TIME:

4.1 Contractor shall commence the Work upon instruction to do so from the Owner and shall achieve Substantial Completion within **Thirty (30) calendar days** from the date the Work is commenced; provided, however, Owner may extend said time period in the event bad weather affects the progress of the Work. Unless otherwise specified in writing, Contractor shall achieve Final Completion within **Thirty (30) calendar days of Substantial Completion**. Owner shall determine when the Project has been fully and finally completed to its satisfaction. The time set forth for completion of the work is an essential element of the Agreement.

4.2 Liquidated Damages.

Contractor acknowledges and recognizes that Owner is entitled to full and beneficial occupancy and use of the completed Work following expiration of the Contract Time and that Owner has entered into, or will enter into, binding agreements upon Contractor's achieving Substantial

Completion of the Work within the Contract Time. Contractor further acknowledges and agrees that if Contractor fails to complete substantially or cause the Substantial Completion of any Phase of the Work within the Contract Time, Owner will sustain extensive damages and serious loss as a result of such failure. In the cases of missed scheduled events, which incur exact losses of revenue and exact expenses for fees and other cancellation costs, Contractor shall be responsible for the exact amount of damages sustained by Owner. In other cases, the exact amount of such damages will be extremely difficult to ascertain. Therefore, Owner and Contractor agree as set forth below:

4.2.1 Subject to the other terms and conditions herein, if Substantial Completion is not achieved by the date specified above or by such date to which the Contract Time may be extended, the Contract Price shall be reduced by **Five Hundred and No/100 Dollars ($500.00) per calendar day** as liquidated damages and not as a penalty, until the date of Substantial Completion. Force majeure shall apply relative to both rain/snow delays (acts of nature) and/or supply delays over which Contractor has no control, and such force majeure delays shall not be subject to such reduction of the Contract Price.

4.2.2 Owner may deduct liquidated damages described herein from any unpaid amounts then or thereafter due Contractor under this Agreement. Any liquidated damages not so deducted from any unpaid amounts due Contractor shall be payable by Contractor to Owner at the demand of Owner, together with the interest from the date of the demand at a rate equal to the prime interest rate as published by the Wall Street Journal on the **first (1st) business day** after such amounts are demanded.

4.2.3 Notwithstanding anything to the contrary in this Agreement, if Owner is unable to recover any portion of liquidated damages in accordance with the terms and conditions herein because it is found to be unenforceable or invalid as a penalty or otherwise, then, Owner shall be entitled to recover from Contractor all of Owner's actual damages in connection with the failure by Contractor to achieve Substantial Completion of the Work within the Contract Time, including, without limitation, direct, indirect, or consequential damages.

ARTICLE 5 PAYMENT:

5.1 Contractor shall receive one lump sum payment of the Contract Price upon completion of the Project.

ARTICLE 6 CONTRACTOR'S GENERAL RESPONSIBILITIES AND COVENANTS:

6.1 Contractor shall render, diligently and competently in accordance with the highest standards used in the profession, all Contractor services which shall be necessary or advisable for the expeditious, economical and satisfactory completion of the Project. Contractor agrees to use its best efforts, skill, judgment, and abilities to perform its obligations and to further the interests of Owner in accordance with Owner's requirements and procedures.

6.2 Contractor's duties as set forth herein shall at no time be in any way diminished by reason of any approval by the Owner nor shall the Contractor be released from any liability by reason of

such approval by the Owner, it being understood that the Owner at all times is ultimately relying upon the Contractor's skill and knowledge in performing the services required hereunder.

6.3 Contractor is responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. The safety program shall comply with all applicable requirements of the current federal Occupational Safety and Health Act and all other applicable federal, state and local laws and regulations.

6.4 Contractor shall be responsible for all construction means, methods, techniques, sequences and procedures, and for coordinating all portions of the Work. The Contractor shall keep the Owner informed of the progress and quality of the Work.

6.5 Insurance. Contractor shall carry insurance in the types and amounts indicated below for the duration of the Agreement, which shall include items owned by Owner in the care, custody and control of Contractor prior to and during construction. Contractor must also complete and file the declaration pages from the insurance policies with Owner whenever a previously identified policy period expires during the term of the Agreement, as proof of continuing coverage. Contractor shall update all expired policies prior to submission of any payment requests hereunder. Failure to update policies shall be reason for payment to be withheld until evidence for renewal is provided to the Owner. If the Contractor fails to obtain, maintain or renew any insurance required by this Agreement, the Owner may, among other remedies available hereunder or at law, obtain insurance coverage directly and recover the cost of that insurance from the Contractor or declare this Agreement void if the Contractor does not remedy the breach within ten (10) days after receipt of notice of breach from the Owner. All policies of insurance provided by the Contractor must comply with the requirements set forth herein, the Agreement and the laws of the State of Texas.

6.5.1 The Contractor shall provide and maintain, until the Work covered in the Agreement is completed and accepted by the Owner, the minimum insurance coverages in the minimum amounts as described below.

	Type of Coverage	Limits of Liability
.1	Worker's Compensation	Statutory
.2	Employer's Liability	
	Bodily Injury by Accident	$500,000 Ea. Accident
	Bodily Injury by Disease	$500,000 Ea. Employee
	Bodily Injury by Disease	$500,000 Policy Limit

.3 Commercial general liability including completed operations and contractual liability insurance for bodily injury, death, or property damages in the following amounts:

COVERAGE	PER OCCURRENCE
Commercial	

General Liability (including premises, completed operations and contractual)	$1,000,000
Aggregate policy limits:	$2,000,000

.4 Comprehensive automobile and auto liability insurance (covering owned, hired, leased and non-owned vehicles):

COVERAGE	PER PERSON	PER OCCURRENCE
Bodily injury (including death)	$1,000,000	$1,000,000
Property damage	$1,000,000	$1,000,000
Aggregate policy limits	No aggregate limit	

.5 Damage to Rented Property/Premises (Ea. Occurrence): $100,000

.6 Builder's Risk Insurance (all-risks)

An all-risk policy, in the amount equal at all times to 100% of the Contract Price. The policy shall include coverage for loss or damage caused by certified acts of terrorism as defined in the Terrorism Risk Insurance Act. The policy shall be issued in the name of the Contractor and shall name its Subcontractors as additional insureds. The Owner shall be named as a loss payee on the policy. The builders risk policy shall have endorsements as follow:

a. This insurance shall be specific as to coverage and not considered as contributing insurance with any permanent insurance maintained on the present premises. If off-site storage is permitted, coverage shall include transit and storage in an amount sufficient to protect property being transported or stored.

b. For renovation projects and or portions of work contained within an existing structure, the Owner waives subrogation for damage by fire to existing building structure(s), if the Builder's Risk Policy has been endorsed to include coverage for existing building structure(s) in the amount described in the Special Conditions. However, Contractor shall not be required to obtain such an endorsement unless specifically required by the Special Conditions, if any. The aforementioned waiver of subrogation shall not be effective unless such endorsement is obtained.

.7 Flood insurance when specified in Supplementary General Conditions or Special Conditions.

.8 Umbrella coverage in the amount of not less than $5,000,000.

6.5.2 Workers' Compensation Insurance Coverage:

1. Definitions:

   (a) Certificate of coverage ("certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the Texas Workers' Compensation Commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the Project.
   (b) Duration of the Project - includes the time from the beginning of the work on the Project until the Contractor's/person's work on the Project has been completed and accepted by the Owner.
   (c) Coverage – Workers' compensation insurance meeting the statutory requirements of the Texas Labor Code, §401.011(44).
   (d) Persons providing services on the Project ("subcontractor") - includes all persons or entities performing all or part of the services the Contractor has undertaken to perform on the Project, regardless of whether that person contracted directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the Project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the Project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

2. The Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, §401.011(44) for all employees of the Contractor providing services on the Project, for the duration of the Project.
3. The Contractor must provide a certificate of coverage prior to execution of the Agreement/Contract, and in no event later than ten (10) days from Notice of Award. Failure to provide the insurance in a timely fashion may result in loss of Contractor's bid bond.
4. If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the Project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the Owner showing that coverage has been extended.
5. The Contractor shall obtain from each person providing services on a project, and provide to the Owner:

(a.) a certificate of coverage, prior to that person beginning work on the Project, so the Owner will have on file certificates of coverage showing coverage for all persons providing services on the Project; and
(b.) no later than seven days after receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project.

6. The Contractor shall retain all required certificates of coverage for the duration of the Project and for one year thereafter.
7. The Contractor shall notify the Owner in writing by certified mail or personal delivery, within 10 days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project.
8. The Contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the Project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

9. The Contractor shall contractually require each person with who it contracts to provide services on a project, to:

(a) provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas labor Code, Section 401.011(44) for all of its employees providing services on the Project, for the duration of the Project;
(b) provide to the Contractor, prior to that person beginning work on the Project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the Project, for the duration of the Project;
(c) provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
(d) obtain from each other person with whom it contracts, and provide to the Contractor:

i. a certificate of coverage, prior to the other person beginning work on the Project; and
ii. a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;

(e) retain all required certificate of coverage on file for the duration of the Project and for one year thereafter;
(f) notify the Owner in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially

affects the provision of coverage of any person providing services on the Project; and

(g) contractually require each person with whom it contracts, to perform as required by paragraphs (a)-(g), with the certificates of coverage to be provided to the person for whom they are providing services.

10. By signing the Agreement/Contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the Owner that all employees of the Contractor who will provide services on the Project will be covered by workers' compensation coverage for the duration of the Project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the Commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

11. The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles the Owner to declare the Agreement/Contract void if the Contractor does not remedy the breach within ten days after receipt of notice of breach from the Owner.

6.5.3 If insurance policies are not written for the amounts specified herein, Contractor shall carry Umbrella or Excess Liability Insurance for any differences in amounts specified. If Excess Liability Insurance is provided, it shall follow the form of primary coverage.

6.5.4 Insurance coverage required hereunder shall be written on an occurrence basis by companies authorized and admitted to do business in the State of Texas and rated A- or better by A.M. Best Company, or otherwise acceptable to Owner.

6.5.5 **The Owner ("Williamson County, Texas"), its officials, employees and volunteers shall be named as an additional insured on all required policies.** These insurance policies shall contain the appropriate additional insured endorsement signed by a person authorized by that insurer to bind coverage on its behalf.

6.5.6 The furnishing of the above listed insurance coverage, as may be modified by the Agreement, must be tendered prior to execution of the Agreement/Contract, and in no event later than ten (10) days from Notice of Award. Failure to provide the insurance in a timely fashion may result in loss of Contractor's bid bond.

6.5.7 Owner reserves the right to review the insurance requirements set forth herein during the Agreement and to make reasonable adjustments to the insurance coverage and their limits when deemed necessary and prudent by the Owner based upon changes in statutory law, court decisions, or the claims history of the industry as well as the Contractor.

6.5.8 Owner shall be entitled, upon request, and without expense, to receive complete copies of the policies with all endorsements and may make any reasonable requests for deletion, or

revision or modification of particular policy terms, conditions, limitations, or exclusions, except where policy provisions are established by law or regulation binding upon the Parties or the underwriter of any of such polices. Damages caused by the Contractor and not covered by insurance shall be paid by the Contractor.

6.5.9 Contractor shall be responsible for payment of premiums for all of the insurance coverages required hereunder. Contractor further agrees that for each claim, suit or action made against insurance provided hereunder, with respect to all matters for which the Contractor is responsible hereunder, Contractor shall be solely responsible for all deductibles and self-insured retentions. Any deductibles or self-insured retentions over $75,000 in the Contractor's insurance must be declared and approved in writing by Owner in advance.

6.5.10 Contractor shall contractually require each person or entity with whom it contracts to provide services in relation to the Work, to comply with every insurance requirement that Contractor must comply with hereunder. More specifically, each person or entity with whom Contractor contracts to provide services on the in relation to the Work must comply with each insurance requirement hereunder just as if such person or entity was the Contractor. Thus, every reference to Contractor under each insurance requirement hereunder shall mean and include each person or entity with whom Contractor contracts to provide services in relation to the Work. If any such person or entity with whom Contractor contracts to provide services in relation to the Work fails to obtain, maintain or renew any insurance required by this Agreement, Owner may, among other remedies available hereunder or at law, obtain insurance coverage directly and recover the cost of that insurance from the Contractor or declare this Agreement void if the Contractor does not remedy the breach within ten (10) days after receipt of notice of breach from the Owner.

ARTICLE 7 INDEMNITY:

7.1 INDEMNIFICATION - EMPLOYEE PERSONAL INJURY CLAIMS. TO THE FULLEST EXTENT PERMITTED BY LAW, Contractor SHALL INDEMNIFY, DEFEND (WITH COUNSEL OF OWNER'S CHOOSING), AND HOLD HARMLESS OWNER, AND OWNER'S EMPLOYEES, AGENTS, REPRESENTATIVES, PARTNERS, OFFICERS, AND DIRECTORS (COLLECTIVELY, THE "INDEMNITEES") AND SHALL ASSUME ENTIRE RESPONSIBILITY AND LIABILITY (OTHER THAN AS A RESULT OF INDEMNITEES' GROSS NEGLIGENCE) FOR ANY CLAIM OR ACTION BASED ON OR ARISING OUT OF THE PERSONAL INJURY, OR DEATH, OF ANY EMPLOYEE OF CONTRACTOR, OR OF ANY SUBCONTRACTOR, OR OF ANY OTHER ENTITY FOR WHOSE ACTS THEY MAY BE LIABLE, WHICH OCCURRED OR WAS ALLEGED TO HAVE OCCURRED ON THE PROJECT SITE OR IN CONNECTION WITH THE PERFORMANCE OF THE WORK. CONTRACTOR HEREBY INDEMNIFIES THE INDEMNITEES EVEN TO THE EXTENT THAT SUCH PERSONAL INJURY WAS CAUSED OR ALLEGED TO HAVE BEEN CAUSED BY THE SOLE, COMPARATIVE OR CONCURRENT NEGLIGENCE OR THE STRICT LIABILITY OF ANY INDEMNIFIED PARTY. THIS INDEMNIFICATION SHALL NOT BE LIMITED TO DAMAGES, COMPENSATION, OR BENEFITS PAYABLE UNDER INSURANCE POLICIES, WORKERS COMPENSATION ACTS, DISABILITY BENEFITS ACTS, OR OTHER EMPLOYEES BENEFIT ACTS.

INDEMNIFICATION - OTHER THAN EMPLOYEE PERSONAL INJURY CLAIMS. TO THE FULLEST EXTENT PERMITTED BY LAW, CONTRACTOR SHALL INDEMNIFY, DEFEND (WITH COUNSEL OF OWNER'S CHOOSING), AND HOLD HARMLESS OWNER, AND OWNER'S EMPLOYEES, AGENTS, REPRESENTATIVES,

PARTNERS, OFFICERS, AND DIRECTORS (COLLECTIVELY, THE "INDEMNITEES") FROM AND AGAINST CLAIMS, DAMAGES, LOSSES AND EXPENSES, INCLUDING BUT NOT LIMITED TO ATTORNEYS' FEES, ARISING OUT OF OR ALLEGED TO BE RESULTING FROM THE PERFORMANCE OF THIS AGREEMENT OR THE WORK DESCRIBED HEREIN, TO THE EXTENT CAUSED BY THE NEGLIGENCE, ACTS, ERRORS, OR OMISSIONS OF CONTRACTOR OR ITS SUBCONTRACTORS, ANYONE EMPLOYED BY THEM OR ANYONE FOR WHOSE ACTS THEY MAY BE LIABLE, REGARDLESS OF WHETHER OR NOT SUCH CLAIM, DAMAGE, LOSS OR EXPENSE IS CAUSED IN WHOLE OR IN PART BY A PARTY INDEMNIFIED HEREUNDER.

7.2 Except for the obligation of Owner to pay Contractor the Contract Price pursuant to the terms of this Agreement, and to perform certain other obligations pursuant to the terms and conditions explicitly set forth herein, Owner shall have no liability to Contractor or to anyone claiming through or under Contractor by reason of the execution or performance of this Agreement. Notwithstanding any obligation or liability of Owner to Contractor, no present or future partner or affiliate of Owner or any agent, officer, director, or employee of Owner, or of the various departments comprising Owner, or anyone claiming under Owner has or shall have any personal liability to Contractor or to anyone claiming through or under Contractor by reason of the execution or performance of this Agreement.

ARTICLE 8 WARRANTY:

8.1 Contractor hereby warrants that the materials and equipment provided for the Work will be of good quality and new unless otherwise required or permitted by the Owner; that the construction will be free from faults and defects; and that the construction will conform with the requirements of the plans, specifications, drawings and the terms of this Agreement.

8.2 Contractor shall provide warranty services for the Work for a **full twelve (12) months** following Final Completion and final payment. Just before the warranty period expires, Contractor shall attend an on-site meeting with the Owner to ensure that all warranty issues have been identified and properly remedied.

ARTICLE 9 PREVAILING WAGE RATE:

9.1 Duty to Pay Prevailing Wage Rates. The Contractor shall pay not less than the wage scale of the various classes of labor as shown on the "Prevailing Wage Schedule", as defined below. The specified wage rates are minimum rates only, and are not representations that qualified labor adequate to perform the Work is available locally at the prevailing wage rates. The Owner is not bound to pay—and will not consider—any claims for additional compensation made by any Contractor because the Contractor pays wages in excess of the applicable minimum rate contained in the Agreement. The "Prevailing Wage Schedule" is not a representation that quantities of qualified labor adequate to perform the Work may be found locally at the specified wage rates.

9.1.2 For classifications not shown, workers shall not be paid less than the wage indicated for Laborers. The Contractor shall notify each worker commencing work on the Project of the worker's job classification and the established minimum wage rate required to be paid, as well as the actual amount being paid. The notice must be delivered to and signed in acknowledgement of receipt by the employee and must list both the monetary wages and fringe benefits to be paid or furnished for each classification in which the

worker is assigned duties. When requested by Owner, competent evidence of compliance with the Texas Prevailing Wage Law shall be furnished by Contractor.

9.1.3 A copy of each worker wage rate notification shall be submitted to the Owner with the Application for Payment for the period during which the worker began on-site activities.

9.2 Prevailing Wage Schedule. Pursuant to Texas Government Code Section 2258.022(2), the general prevailing rate of per diem wages for each craft or type of worker needed to execute the Contract and the prevailing rate for legal holiday and overtime work shall be the most recent prevailing wage rate for Williamson County, Texas for building construction as determined by the United States Department of Labor in accordance with the Davis-Bacon Act (40 U.S.C. Section 276a et seq.), and its subsequent amendments, which are published and can be obtained online at https://sam.gov/search/?index=dbra (the "Prevailing Wage Schedule"). Should the Contractor at any time become aware that a particular skill or trade not reflected on the Prevailing Wage Schedule will be or is being employed in the Work, whether by the Contractor or by a subcontractor, the Contractor shall promptly inform the Owner and shall specify a wage rate for that skill or trade, which shall bind the Contractor.

9.3 Penalty for Violation. The Contractor and any Subcontractor shall pay to the Owner a penalty of sixty dollars ($60.00) for each worker employed for each calendar day, or portion thereof, that the worker is paid less than the wage rates stipulated in the Prevailing Wage Schedule or any supplement or update thereto pursuant to previsions above. The Contractor and each Subcontractor shall keep, or cause to be kept, an accurate record showing the names and occupations of all workers employed in connection with the Work, and showing the actual per diem wages paid to each worker, which records shall be open at all reasonable hours for the inspection by the Owner.

9.4 Complaints of Violations of Prevailing Wage Rates. Within thirty-one (31) days of receipt of information concerning a violation of Texas Government Code, Chapter 2258, the Owner shall make an initial determination as to whether good cause exists to believe a violation occurred. The Owner's decision on the initial determination shall be reduced to writing and sent to the Contractor or Subcontractor against whom the violation was alleged, and to the affected worker. When a good cause finding is made, the Owner shall retain the full amounts claimed by the claimant or claimants as the difference between wages paid and wages due under the Prevailing Wage Schedule and any supplements thereto, together with the applicable penalties, such amounts being subtracted from successive progress payments pending a final decision on the violation.

9.5 Arbitration Required if Violation not Resolved. After the Owner makes its initial determination, the affected Contractor or Subcontractor and worker have fourteen (14) days in which to resolve the issue of whether a violation occurred, including the amount that should be retained by Owner or paid to the affected worker. If the Contractor or Subcontractor and affected worker reach an agreement concerning the worker's claim, the Contractor shall promptly notify the Owner in a written document signed by the worker. If the Contractor or Subcontractor and affected worker do not agree before the fifteenth (15^{th}) day after the Owner's determination, the Contractor or Subcontractor and affected worker must participate in binding arbitration in

accordance with the Texas General Arbitration Act, Chapter 171, Tex. Civ. Prac. & Rem. Code. The parties to the arbitration have ten (10) days after the expiration of the fifteen (15) days referred to above, to agree on an arbitrator; if by the eleventh (11^{th}) day there is no agreement to an arbitrator, a district court shall appoint an arbitrator on the petition of any of the parties to the arbitration.

9.6 Arbitration Award. If an arbitrator determines that a violation has occurred, the arbitrator shall assess and award against the Contractor or Subcontractor the amount of penalty as provided herein and the amount owed the worker. The Owner may use any amounts retained hereunder to pay the worker the amount as designated in the arbitration award. If the Owner has not retained enough from the Contractor or Subcontractor to pay the worker in accordance with the arbitration award, the worker has a right of action against the Contractor and Subcontractor as appropriate, and the surety of either to receive the amount owed, attorneys' fees and court costs. The Contractor shall promptly furnish a copy of the arbitration award to the Owner.

9.7 Prevailing Wage Retainage. Money retained pursuant to this section shall be used to pay the claimant or claimants the difference between the amount the worker received in wages for labor on the Project at the rate paid by the Contractor or Subcontractor and the amount the worker would have received at the general prevailing wage rate as provided by the agreement of the claimant and the Contractor or Subcontractor affected, or in the arbitrator's award. The full statutory penalty of sixty dollars ($60.00) per day of violation per worker shall be retained by the Owner to offset its administrative costs, pursuant to Texas Government Code, §2258.023. Any retained funds in excess of these amounts shall be paid to the Contractor on the earlier of the next progress payment or final payment. Provided, however, that the Owner shall have no duty to release any funds to either the claimant or the Contractor until it has received the notices of agreement or the arbitration award as provided in this section.

9.8 No Extension of Time. If the Owner determines that good cause exists to believe a violation has occurred, the Contractor shall not be entitled to an extension of time for any delay arising directly or indirectly from of the procedures set forth in this section.

ARTICLE 10 BONDS:

10.1 Performance Bond. Upon execution of this Agreement, Contractor shall provide a Performance Bond in the amount of 100% of the Contract Price. The surety for a Performance Bond shall meet the requirements of Texas law and the requirements set forth in the Agreement.

10.2 Payment Bond. Upon execution of this Agreement, Contractor shall provide a Payment Bond in the amount of 100% of the Contract Price, as security for the true and faithful payment in full of all subcontractors and persons performing labor, services, materials, machinery, and fixtures in connection with the Work. The surety for a Payment Bond shall meet the requirements of Texas law and the requirements set forth in the Agreement.

10.3 Warranty Bond. Upon Final Completion, Contractor shall provide a Warranty Bond in the amount of 20% of the Contract Price, as security for the true and faithful performance of all warranties set forth in the Agreement.

ARTICLE 11 TERMINATION OR SUSPENSION OF THE AGREEMENT

11.1 Termination by Contractor

If one of the reasons described below exists, the Contractor may, upon thirty (30) business days written notice to the Owner, terminate the Agreement and recover from the Owner payment for Work executed, including reasonable overhead, profit, and costs incurred by reason of such termination:

11.1.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

11.1.2 An act of government, such as a declaration of national emergency that requires all Work to be stopped;

11.1.3 If the Work is stopped for a period of ninety (90) consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Agreement.

11.2 Termination by the Owner for Cause

11.2.1 The Owner may terminate the Agreement if the Contractor:

11.2.1.1 Fails to commence the Work in accordance with the provisions of the Agreement;

11.2.1.2 Fails to prosecute the Work to completion thereof in a diligent, efficient, timely, workmanlike, skillful and careful manner and in strict accordance with the provisions of the Agreement;

11.2.1.3 Fails to use an adequate amount or quality of personnel or equipment to complete the Work without undue delay;

11.2.1.4 Fails to perform any of its obligations under the Agreement;

11.2.1.5 Fails to make prompt payments when due to its Subcontractors and Suppliers, or as required by **Texas Government Code, Chapter 2251**;

11.2.1.6 Files any petition or other pleading seeking any relief under any provisions of the Federal Bankruptcy Act, as amended, or any other federal or state statute or law providing for reorganization of debts or other relief from creditors, permits a receiver or other person to be appointed on account of its insolvency or financial condition, or becomes insolvent;

11.2.1.7 Creates any situation or state of facts which would authorize or permit an involuntary petition in bankruptcy to be filed against Contractor; or

11.2.1.8 Has not met or in Owner's opinion will not meet the dates of Substantial Completion set forth in the Agreement.

11.2.2 When any of the reasons under **Paragraph 11.2.1** exist, the Owner, in its sole and absolute discretion, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, **thirty (30) calendar days** written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety, exclude the Contractor from the Project site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor; accept assignment of subcontracts of Contractors subcontractors; and finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

11.2.3 When the Owner terminates the Agreement for one of the reasons stated in **Paragraph 11.2.1**, the Contractor shall not be entitled to receive payment until the Work is finished. In the event that it is determined that sufficient cause did not exist for termination under this **Section 11.2**, then the termination shall be considered a termination for convenience, under **Section 11.4**, below.

11.2.4 If the unpaid balance of the Contract Price exceeds costs of finishing the Work, including compensation for expenses made necessary thereby, and other damages and costs incurred by the Owner in finishing the Work and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner.

11.3 Suspension by the Owner for Convenience

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

11.3.2 The Contract Price and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in **Paragraph 11.3.1**. Adjustment of the Contract Price shall include profit. No adjustment shall be made to the extent:

11.3.2.1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or

11.3.2.2 that an equitable adjustment is made or denied under another provision of the Agreement.

11.4 Termination by the Owner for Convenience

11.4.1 The Owner may, at any time, terminate the Agreement for the Owner's convenience and without cause.

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

11.4.2.1 Cease operations as directed by the Owner in the notice;

11.4.2.2 Take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

11.4.2.3 Except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

11.4.3 Upon Owner's termination for convenience, costs of the Work executed, including reasonable overhead and profit, incurred to and including the date of termination, will be due and payable to Contractor in accordance with the Agreement.

ARTICLE 12 MISCELLANEOUS PROVISIONS:

12.1 Interest and Late Payments. Owner's payment for goods and services shall be governed by Chapter 2251 of the Texas Government Code. Interest charges for any overdue payments shall be paid by Owner in accordance with Texas Government Code Section 2251.025. More specifically, the rate of interest that shall accrue on a late payment is the rate in effect on September 1 of Owner's fiscal year in which the payment becomes due. The said rate in effect on September 1 shall be equal to the sum of one percent (1%); and (2) the prime rate published in the Wall Street Journal on the first day of July of the preceding fiscal year that does not fall on a Saturday or Sunday.

In the event that an error appears in an invoice/application for payment submitted by Contractor, Owner shall notify Contractor of the error not later than the twenty first (21st) day after the date Owner receives the invoice/application for payment. If the error is resolved in favor of Contractor, Contractor shall be entitled to receive interest on the unpaid balance of the invoice/application for payment submitted by Contractor beginning on the date that the payment for the invoice/application for payment became overdue. If the error is resolved in favor of the Owner, Contractor shall submit a corrected invoice/application for payment that must be paid in accordance within the time set forth above. The unpaid balance accrues interest as provided by Chapter 2251 of the Texas Government Code if the corrected invoice/application for payment is not paid by the appropriate date.

12.2 Audits. Contractor agrees that Owner or its duly authorized representatives shall, until the expiration of three (3) years after final payment under this Agreement, have access to and the right to examine and photocopy any and all books, documents, papers and records of Contractor which are directly pertinent to the services to be performed under this Agreement for the purposes of making audits, examinations, excerpts, and transcriptions. Contractor agrees that Owner shall have access during normal working hours to all necessary Contractor facilities and shall be provided adequate and appropriate work space in order to conduct audits in compliance with the provisions of this section. Owner shall give Contractor reasonable advance notice of intended audits.

12.3 Assignment. This Agreement is a personal service contract for the services of Contractor, and Contractor's interest in this Agreement, duties hereunder and/or fees due hereunder may not be assigned or delegated to a third party.

12.4 Governing Law and Venue. This Agreement and all of the rights and obligations of the parties and all of the terms and conditions shall be construed, interpreted and applied in accordance with and governed by and enforced under the laws of the State of Texas without reference to its conflicts of law provisions. Williamson County, Texas where the Project is located shall be the sole place of venue for any legal action arising from or related to this Agreement or the Project in which the Owner is a party.

12.5 Binding Effect. This Agreement shall be binding upon and inure to the benefit of the parties and their respective permitted assigns and successors.

12.6 Notices. All notices, consents, approvals, demands, requests or other communications relied on by the parties shall be in writing. Written notice shall be deemed to have been given when delivered in person to the designated representative of the Contractor or Owner for whom it is intended; or sent by U. S. Mail to the last known business address of the designated representative.

12.7 Severability. Should any term or provision of this Agreement be held invalid or unenforceable in any respect, the remaining terms and provisions shall not be affected and this Agreement shall be construed as if the invalid or unenforceable term or provision had never been included.

12.8Relationship of the Parties. Contractor shall be an independent contractor under this agreement and shall assume all of the rights, obligations, liabilities, applicable to it as such independent contractor hereunder and any provisions in this agreement which may appear to give Owner the right to direct Contractor as to details of doing the Work herein covered or to exercise a measure of control over the Work shall be deemed to mean that Contractor shall follow the desires of Owner in the results of the Work only. Owner shall not retain or have the right to control the Contractor's means, methods or details pertaining to the Contractor's performance of the Work described herein, nor shall Owner have the power to direct the order in which Contractor's Work is performed under this agreement. Owner and Contractor hereby agree and declare that Contractor is an Independent Contractor and as such meets the qualifications of an Independent Contractor under Texas Worker's Compensation Act, Texas Labor Code, Section 406.141, that the Contractor is not an employee of Owner for purposes of this Agreement, and that the Contractor and its employees, agents and sub-subcontractors shall not be entitled to worker's compensation coverage or any other type of insurance coverage held by Owner.

12.9 Force Majeure. If the party obligated to perform is prevented from performance by an act of war, order of legal authority, act of God, or other unavoidable cause not attributable to the fault or negligence of said party, the other party shall grant such party relief from the performance of this Agreement. The burden of proof for the need of such relief shall rest upon the party obligated to perform. To obtain release based on force majeure, the party obligated to perform shall file a written request with the other party.

12.10 No Waiver of Sovereign Immunity. Nothing herein shall be construed as a waiver of sovereign immunity by Owner.

12.11 Current Revenues. Under Texas law, a contract with a governmental entity that contains a claim against future revenues is void; therefore, each party paying for the performance of governmental functions or services must make those payments from current revenues available to the paying party.

12.12 Compliance with Laws. Contractor shall comply with all federal, state, and local laws, statutes, ordinances, rules and regulations, and the orders and decrees of any courts or administrative bodies or tribunals in any matter affecting the performance of this Agreement, including, without limitation, Worker's Compensation laws, minimum and maximum salary and wage statutes and regulations, licensing laws and regulations. When required, Contractor shall furnish the Owner with certification of compliance with said laws, statutes, ordinances, rules, regulations, orders, and decrees above specified.

12.13 Entire Agreement & Incorporated Documents; Conflicting Terms. This Agreement constitutes the entire agreement between the parties and may not be modified or amended other than by a written instrument executed by both parties.

The following documents shall comprise the Contract Documents:

1. This Agreement between Owner and Contractor;
2. Exhibit "A" – Plans and Specifications;
3. Addenda issued prior to the Effective Date of this Agreement;
4. Cooperative Contract # CSP-22-049MF; and
5. All Change Orders and any other Modifications issued after the Effective Date of this Agreement.

In the event of a dispute or conflict relating to the terms and conditions of the Contract Documents, applicable documents will be referred to for the purpose of clarification, conflict resolution or for additional detail in the following order of precedence:

1. This Agreement between Owner and Contractor;
2. Exhibit "A" – Plans and Specifications;
3. Addenda issued prior to the Effective Date of this Agreement;
4. Cooperative Contract # CSP-22-049MF; and
5. All Change Orders and any other Modifications issued after the Effective Date of this Agreement.

BY SIGNING BELOW, the Parties have executed and bound themselves to this Agreement to be effective as of the date of the last party's execution hereof.

OWNER:	**CONTRACTOR:**
WILLIAMSON COUNTY, TEXAS, a political subdivision of the state of Texas	The Brandt Companies, LLC
By: Steve Snell (Jul 16, 2025 22:53 CDT)	By:
Printed Name: Steve Snell	Printed Name: Jordan Green
Title: Williamson County Judge	Title: VP of Operations
Date:	Date: 6/25/2025

Exhibit “A”

Plans and Specifications

Location of Work: 508 S Rock St, Georgetown, TX 78626

SCOPE OF WORK:

1. Labor, material, and equipment to install the HVAC and Plumbing per Bid documents:
    a. Drawings: CZE Project No. 240797 Dated 05-15-2025.
2. The dishwasher will remain online by utilizing the existing exhaust system until all new ductwork and the exhaust fan are installed.
3. Install a temporary plastic barrier in the kitchen area where the new exhaust duct will run.
4. Remove the ceiling and grid for the path of the new duct system above the ceiling grid.
5. Run approximately 95 feet of 8” 304 SS KB style clamp round duct from the existing dishwasher to the north side of the building, including installing a fire damper, motorized damper, and back draft damper between the interior wall and the exterior wall. The duct will be sloped towards the dishwasher following the specifications.
6. Duct work will be 304 SS KB clamp style for servicing needs for cleanouts.
7. Core drill (1) 8” diameter hole through a brick wall approximately 9 feet high on the north side of the building.
8. Mount (1) Greenheck Exhaust Fan (Model #-CUE-100HP-VG) on the north side of a building in a horizontal position.
9. Run a new 115-volt circuit from the existing electrical panel LK3 in the electrical room labeled J1123 to the new exhaust fan. Terminate the electrical connections at the breaker panel and the exhaust fan.
10. Controls Scope of Work:
    a. Provide DDC Controller and Panel.
    b. Provide Fan Start/Stop with fan status.
    c. Provide Motorized Damper control.
    d. Provide web-based Automated Logic WebCTRL Graphical User Interface (GUI) software with all programming, including database configuration and graphics.
11. Shut down the dishwasher, disconnect existing ductwork, and connect the new ductwork to the existing dishwasher.
12. Start the new exhaust system and check the operation.
13. Perform Test & Balance on the exhaust system.
14. Demo the existing dishwasher exhaust from the first floor to the chase. Ductwork cannot be accessed from the second to the third floor due to a lack of access to the chase. Ductwork does not run in the elevator shaft as shown on the prints. Contractor will remove and cap the exhaust that is accessible from the 1st floor.
15. The exhaust duct on the 4th floor will be removed from the center block wall. The center block wall will be filled in where the ductwork was exiting.
16. Existing exhaust fan, electrical, and duct work will be demoed on the roof. A roof cap will be installed on the existing roof penetration.
17. Reinstall the ceiling and grid. Remove the temporary wall and clean the work area.

Contractor Exclusions:

1. Sales or Remodel Taxes.
2. Overtime or after-hours work.
3. Removed
4. Interlocks, fire system.
5. BIM, BIM Coordination, Engineering fees unless specifically noted in "Scope of Work".
6. Business interruptions or losses resultant there from consequential damages.
7. Telephone Computer, Data, Fire Alarm, MNS, Fire Suppression, Security, CCTV/MATV, Public Address, Sound, POS, BAS, Energy Management, Carbon Monoxide systems, raceways and/or cabling unless specifically noted in "Scope of Work".
8. Mechanical, Electrical or Structural Engineering services.
9. BIM or 3D Modeling Coordination.
10. Any lightning protection scope.
11. Maintenance, Warranty, or repairs to existing equipment.
12. Repairs due to existing Code violations.
13. Removal and replacement of gypsum or lay-in ceilings for access to work areas.
14. Relocation of furniture, equipment, or personnel for access to work areas.
15. Concrete patching, pour-back or grouting of cored holes or saw-cut trenches.
16. Patching, painting or touch-up of any floors, walls, or ceilings.
17. Any added Structural support required for new HVAC equipment.
18. Fire or Fire/Smoke Dampers, except where shown on Mechanical Drawings.
19. Smoke detectors, sensors, strobes, wiring or interface with Fire Alarm system.
20. Temporary utilities or spot cooling/heating during construction.
21. Cleaning of existing ductwork.
22. Cleaning existing air devices.
23. Protecting existing air devices during construction.
24. Indoor Air Quality Management or Testing.
25. Provisions for negative air pressure or Infectious Disease Control during construction.
26. Painting or priming of equipment, fixtures, ductwork, or piping.
27. Architectural louvers or access panels.
28. Fire Protection piping, smoke/heat detectors, alarms, or VESDA systems.
29. Hazardous waste removal if encountered.
30. Density tests or x-ray of structure.

Contractor Clarifications:

1. Current lead time for equipment and materials (8 to 9 weeks)
2. Drawings show existing ductwork running through an elevator shaft. Contractor will field verified that there is no ductwork in the elevator shaft. Contractor will demo all existing ductwork that is accessible.
3. Contractor will attend coordination meetings. Any additional meeting requirements by GC or Owner will incur costs.
4. Contractor did not include taxes on imported materials or equipment due to unestablished trade agreements. Any tax increases resulting from unforeseen circumstances may incur additional costs.
5. All warranties for new equipment provided and installed by Contractor as listed in the scope of work shall begin on the date the equipment is started up.

6. Contractor's pricing does not include provisions for any off-site equipment storage.
7. Contractor assumes the customer has a valid existing asbestos survey, and there are no VOC elements related to this scope of work.
8. Any lead times shown start from time of approved submittals and are subject to change.
9. Contractor has based proposed work on preliminary engineering design. If final engineering and design results in changes to equipment selections, mechanical plans, plumbing plans and or electrical plans additional cost may be incurred.
10. Contractor is utilizing drawings as provided; mechanical changes could impact existing building HVAC systems including balance. In some cases, Contractor recommends a pre-construction TAB profile to proactively identify potential issues. Additional TAB procedures needed for HVAC systems not specified in the Contract after construction could incur additional cost.
11. Mechanical, Electrical or Structural Engineering services.
12. Contractor's pricing is conditioned upon prompt award of the project contract, in sufficient time to allow approval of submittals and procurement of materials and equipment in order to meet the project schedule.
13. Any lightning protection scope.
14. Contractor will promptly submit pricing for any changes, modifications, or additions to the scope of work set out in the Contract. Contractor will not be required to proceed with any changed/additional/modified work until it receives a signed change order at a mutually agreed upon price. If Contractor is directed to proceed and time is of the essence, Contractor will only be required to perform the changed/additional/modified work upon receiving a signed "time and materials" work order. The cost and Contractor's fee for this T&M work may be billed during the billing period in which the work is performed and will be due and paid within 30 days.

WILLIAMSON COUNTY

JAIL NORTH DISHWASHER EXHAUST

306 W 4TH ST, GEORGETOWN, TX 78626

CLEARY ZIMMERMANN ENGINEERS

Firm No. F-9357 | ClearyZimmermann.com

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AREA OF WORK:

1 G000 SITE MAP

WILLIAMSON COUNTY
Jail North Dishwasher Exhaust
306 W 4th Street
Georgetown, TX 78626

Drawn	CZE
Checked	CZE
Date	05-15-2025
Project No.	240797
Revisions	

SHEET TITLE

PROJECT COVER SHEET

SHEET NO.

G000

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SYMBOLS AND ABBREVIATIONS

GENERAL

- MOTOR, HP AS INDICATED
- CONTROLLER TO BE FURNISHED UNDER DIVISION 15 AND INSTALLED UNDER DIVISION 16
- DISCONNECT SWITCH
- MAGNETIC MOTOR STARTER
- COMBINATION MOTOR STARTER/DISCONNECT SWITCH
- GROUNDING REFERENCE POINT.
- JUNCTION BOX, CEILING MOUNTED
- JUNCTION BOX, WALL MOUNTED
- PC — PHOTO CELL
- R — RELAY
- TC — TIME CLOCK
- C — CONTACTOR
- BELL
- BUZZER
- CEILING MOUNTED CLOCK
- WALL MOUNTED CLOCK
- WALL MOUNTED DOUBLE FACE CLOCK
- TV — HORN
- A — TRANSFORMER AS INDICATED
- ATS — AUTOMATIC TRANSFER SWITCH
- EQUIPMENT CONNECTION
- 2 — KEYED NOTE NO. 2
- CH- — MECHANICAL EQUIPMENT DESIGNATION

LUMINAIRES

- LUMINAIRE, CEILING OR WALL MOUNTED. SUBSCRIPT INDICATES ASSOCIATED ZONING. CAPITAL LETTER INDICATES FIXTURE TYPE.
- FIXTURE CEILING MOUNTED
- FIXTURE WALL MOUNTED
- WALLWASH FIXTURE CEILING MOUNTED
- EXIT LIGHT, CEILING MOUNTED WITH ARROWS
- EXIT LIGHT, WALL MOUNTED WITH ARROWS
- EMERGENCY FIXTURE
- FIXTURE WITH EMBEDDED WIRELESS OCCUPANCY AND DAYLIGHT SENSOR
- EMERGENCY LIGHT, WALL MOUNTED
- POLE MOUNTED LUMINAIRE
- FLOOD LIGHT. ARROW INDICATES AIMING DIRECTION.
- TRACK LIGHT WITH HEADS AS INDICATED

RACEWAYS

- CONDUIT CONCEALED IN WALL OR CEILING
- CONDUIT UNDER FLOOR OR CAST IN STRUCTURE
- SWITCH LEG
- P1A-2,4,6 — BRANCH CIRCUIT HOMERUN 3/4"C, 3#12 AND 1#12 GND. MIN.
- SURFACE RACEWAY
- T — TELEPHONE
- BUS DUCT WITH TAKE OFF DEVICE

PANEL AND RELATED ITEMS

- PANELBOARD, SURFACE MOUNTED.
- PANELBOARD, FLUSH MOUNTED.
- SWBD — SWITCHBOARD OR DISTRIBUTION BOARD
- MCC — MOTOR CONTROL CENTER
- TVSS — TRANSIENT VOLTAGE SURGE SUPPRESSOR.
- TELE — PLYWOOD TELEPHONE BACKBOARD: PROVIDE WALL MOUNTED WHITE PAINTED 4x8' PLYWOOD BACKBOARD

OUTLETS

- SIMPLEX RECEPTACLE
- DUPLEX RECEPTACLE
- WP, T, GFI, IG C, TV, CR — DUPLEX RECEPTACLE; GFI=GROUND FAULT INTERRUPTING, WP=WEATHERPROOF, T=TAMPER RESISTANT, IG=ORANGE SOLATED GROUND, C=CLOCK OUTLET, TV=TV RECEPTACLE, CR=CONTROLLED RECEPTACLE
- DOUBLE DUPLEX RECEPTACLE
- EMERGENCY RED DUPLEX RECEPTACLE
- EMERGENCY RED QUAD RECEPTACLE
- DUPLEX RECEPTACLE WITH USB PORTS
- SPECIAL PURPOSE RECEPTACLE
- ROUND FLOOR BOX WITH POWER AND DATA
- SQUARE FLOOR BOX WITH POWER AND DATA
- TELEPHONE OUTLET
- TELEVISION OUTLET
- VOICE/DATA OUTLET

SWITCHES

- SINGLE POLE SWITCH
- DOUBLE POLE SWITCH
- THREE-WAY SWITCH
- FOUR-WAY SWITCH
- CEILING FAN SPEED SWITCH
- SWITCH WITH PILOT LIGHT IN HANDLE
- WEATHERPROOF SWITCH
- MOTOR RATED SWITCH
- EXPLOSION PROOF SWITCH
- TIMER SWITCH
- MULTIPLE SWITCHES, GANGED.
- CEILING MOUNTED OCCUPANCY SENSOR
- WALL MOUNTED OCCUPANCY SENSOR AND SWITCH
- LOW VOLTAGE SWITCH
- LOW VOLTAGE SWITCH WITH DIMMER
- WALL MOUNTED WIRELESS ON/OFF SWITCH
- WALL MOUNTED WIRELESS ON/OFF/DIM SWITCH
- WALL MOUNTED WIRELESS ON/OFF/DIM SWITCH WITH QUANTITY

FIRE ALARM

- FACP — FIRE ALARM CONTROL PANEL
- FAEX — FIRE ALARM EXPANSION PANEL
- ANN — REMOTE FIRE ALARM ANNUNCIATOR
- F — MANUAL PULL STATION
- SD — SMOKE DETECTOR; DASHED INDICATES BELOW RAISED FLOOR
- SD_D — SMOKE DETECTOR, DUCT MOUNTED
- T — TEST SWITCH
- HD — HEAT DETECTOR
- FS — FLOW SWITCH
- VS — VALVE SWITCH
- FS — FLOW SWITCH
- F — AUDIO-VISUAL ANNUNCIATOR (WALL, CEILING)
- V — VISUAL ANNUNCIATOR (WALL, CEILING)
- DH — MAGNETIC DOOR HOLDER
- PJ — FIRE FIGHTERS PHONE JACK
- S_F — FIRE ALARM SPEAKER / VISUAL (VOICE EVACUATION)

DISTRIBUTION

- MOLDED CASE CIRCUIT BREAKER
- DRAWOUT POWER CIRCUIT BREAKER AIR, VACUUM OR SF AS SPECIFIED.
- DISCONNECT SWITCH
- FUSIBLE DISCONNECT SWITCH
- TRANSFORMER
- SHEILDED ISOLATION TRANSFORMER
- VM — VOLTMETER
- AM — AMMETER
- VS — VOLTMETER SELECTOR SWITCH
- AS — AMMETER SELECTOR SWITCH
- ST — SHUNT TRIP
- M — CT AND METER

ABBREVIATIONS

A	AMPERE(S)
AC	ABOVE COUNTER
A/C	AIR CONDITIONING
AIC	AMPERE INTERRUPTING CAPACITY
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AHU	AIR HANDLING UNIT
AL , ALUM	ALUMINUM
ATS	AUTOMATIC TRANSFER SWITCH
AWG	AMERICAN WIRE GAUGE
BLDG	BUILDING
C	CONDUIT
CB	CIRCUIT BREAKER
CCTV	CLOSED CIRCUIT TELEVISION
CFCI	CONTRACTOR FURNISHED, CONTRACTOR INSTALLED
CKT	CIRCUIT
COND	CONDUCTOR
CPU	CENTRAL PROCESSING UNIT
CT	CURRENT TRANSFORMER
DCP	DATA COLLECTION PANEL
DIA	DIAMETER
DC	DISCONNECT
DIST	DISTRIBUTION
DN	DOWN
DWGS	DRAWINGS
EC	EMPTY CONDUIT
EF	EXHAUST FAN
EQMT	EQUIPMENT
EWC	ELECTRIC WATER COOLER
EXH	EXHAUST
EXP	EXPLOSION PROOF
EXTG	EXISTING
F/A , F.A.	FIRE ALARM
FLUOR	FLUORESCENT
FN	FULL NEUTRAL
FT	FEET, FOOT
GALV	GALVANIZED
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GFI	GROUND FAULT INTERRUPTER
GND	GROUND
GRD	GALVANIZED RIGID STEEL
HID	HIGH INTENSITY DISCHARGE
HP	HORSEPOWER
HOA	HAND OFF AUTOMATIC
HPS	HIGH PRESSURE SODIUM
HVAC	HEATING/VENTILATING/AIR CONDITIONING
HZ	HERTZ
ID	INSIDE DIAMETER

ABBREVIATIONS

IG	ISOLATED GROUND
IMC	INTERMEDIATE STEEL CONDUIT
IN	INCHES
INCD	INCANDESCENT
JB	JUNCTION BOX
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KVAC	KILOVOLT AMPERE CAPACTIVE
KVAR	KILOVOLT AMPERE REACTIVE
KW	KILOWATT
KWH	KILOWATT HOUR
LPS	LOW PRESSURE SODIUM
MAX	MAXIMUM
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MDP	MAIN DISTRIBUTION PANEL
MECH	MECHANICAL
MH	METAL HALIDE
MIN	MINIMUM
MLO	MAIN LUGS ONLY
MTD	MOUNTED
MTG	MOUNTING
MV	MERCURY VAPOR
MW	MICROWAVE
NA	NOT APPLICABLE
NC	NORMALLY CLOSED
NF	NONFUSIBLE
NL	NIGHT LIGHT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OC	ON CENTER
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
OH	OVERHEAD
P	POLE
PA	PUBLIC ADDRESS
PB	PUSHBUTTON
PBX	PRIVATE BUILDING EXCHANGE
PC	PULL CHAIN
P/C	PHOTO CELL
PDP	POWER DISTRIBUTION PANEL
PH , Ø	PHASE
PNL	PANELBOARD
PR	PAIR
PSI	POUNDS PER SQUARE INCH
PWR	POWER
QUAD	QUAD RECEPTACLE
REFR	REFRIGERATOR
S	SECURITY
S.C.	SPLIT CIRCUIT
SCC	STATUS COMMAND CENTER
SN	SOLID NEUTRAL
SPD	SURGE PROTECTION DEVICE
SQFT.	SQUARE FOOT
SW	SWITCH
SWBD	SWITCHBOARD
TC	TIME CLOCK
TELE	TELEPHONE
TSTAT	THERMOSTAT
TV	TELEVISION
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR
UON	UNLESS OTHERWISE NOTED
UPS	UNINTERRUPTABLE POWER SUPPLY
V	VOLT(S)
VEND	VENDING
VP	VAPOR PROOF
W	WIRE , WATT(S)
WP	WEATHERPROOF
XFMR	TRANSFORMER
1P	ONE POLE
2P	TWO POLE
3P	THREE POLE

WILCO TEXAS

CLEARY ZIMMERMANN ENGINEERS
Firm No. F-9357 | ClearyZimmermann.com

STATE OF TEXAS
AARON T. LOVELOCK
145763
LICENSED PROFESSIONAL ENGINEER
05/15/2025

WILLIAMSON COUNTY
Jail North Dishwasher Exhaust
306 W 4th Street
Georgetown, TX 78626

Drawn	CZE
Checked	CZE
Date	05-15-2025
Project No.	240797
Revisions	

SHEET TITLE

ELECTRICAL SYMBOLS AND ABBREVIATIONS

SHEET NO.

E000

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MECHANICAL/REFRIGERATION SYMBOLS AND ABBREVIATIONS

NOTE: SELDOM ARE ALL SYMBOLS AND ABBREVIATIONS USED IN THE DRAWINGS; REFERENCE ONLY THOSE THAT ARE APPLICABLE.

SYMBOL	DESCRIPTION
30x24	DUCT SIZE FIRST FIGURE IS SIDE SHOWN
30x24	DUCT SECTION, POSITIVE PRESSURE, FIRST FIGURE IS TOP
30x24	DUCT SECTION, NEGATIVE PRESSURE, FIRST FIGURE IS TOP
UP	CHANGE OF ELEVATION - UP OR DOWN
	DEMOLITION DUCTWORK
	EXISTING DUCT TO REMAIN
	FLEXIBLE DUCT
	MANUAL VOLUME DAMPER
FD	FIRE DAMPER (W/ ACCESS DOOR) SD=SMOKE DAMPER; SFD=SMOKE/FIRE DAMPER
12"	SPLITTER DAMPER (WITH DIMENSION AS NEEDED)
FD SD	DETECTORS, FIRE AND/OR SMOKE
24x8 12x8	DUCT TRANSITION
	ELBOWS WITH TURNING VANES
VD	BRANCH DUCT WITH HEEL TAP AND DAMPERS (RETURN DUCT FLOW IS REVERSE)
A 200	SUPPLY GRILLE OR REGISTER, SIDEWALL TYPE "A", 200 CFM.
A 300	AIR DEVICE TYPE "A", 300 CFM
A 300	AIR DEVICE TYPE "A", 300 CFM
A 200	LINEAR SLOT DEVICE TYPE "A", 200 CFM
A	RETURN/EXHAUST DEVICE TYPE "A"
A	RETURN/EXHAUST GRILLE OR REGISTER, SIDEWALL, DEVICE TYPE "A"
3	KEY NOTES
AHU-1	EQUIPMENT MARK
T	THERMOSTAT/TEMPERATURE SENSOR

SYMBOL	DESCRIPTION
	CALIBRATED BALANCING VALVE
	PRESSURE REDUCING VALVE
	PRESSURE RELIEF VALVE
T&P	TEMPERATURE AND PRESSURE RELIEF VALVE
M	THREE WAY VALVE (AUTOMATIC)
M	TWO WAY VALVE (AUTOMATIC)
F.S.	FLOW SWITCH
	STRAINER, WYE WITH DRAIN VALVE
	GLOBE VALVE
	BUTTERFLY VALVE
	HOSE VALVE (UTILITY PURPOSES)
	SWING CHECK VALVE
	NEW TO EXISTING CONNECTION
CWS	CHILLED WATER SUPPLY
CWR	CHILLED WATER RETURN
RL	REFRIGERANT LIQUID LINE
RS	REFRIGERANT SUCTION LINE
	NON-SLAM CHECK VALVE
	BALL VALVE
	FLOW - IN DIRECTION OF ARROW
	RISER DOWN (ELBOW)
	RISER UP (ELBOW)
	RISE OR DROP
	BRANCH CONNECTION OUT OF TOP
	BRANCH CONNECTION OUT OF BOTTOM
	BRANCH CONNECTION OUT OF SIDE
	CAP ON END OF PIPE

ABBREVIATION	DESCRIPTION
ABV	ABOVE
AFF	ABOVE FINISHED FLOOR
AV	AIR VENT
BF	BELOW FLOOR
BHP	BRAKE HORSEPOWER
BTU	BRITISH THERMAL UNIT
CFM	CUBIC FEET PER MINUTE
CLG	CEILING
CONNX/CONX.	CONNECTION
CONT	CONTINUATION
℄	CENTERLINE
CW	CHILLED WATER
DB	DRYBULB
DN	DOWN
DWG	DRAWING
EAT	ENTERING AIR TEMPERATURE
ELECT	ELECTRICAL
ELEV	ELEVATION
ENT	ENTERING
EXIST	EXISTING
F	FAHRENHEIT
FD	FLOOR DRAIN OR FIRE DAMPER
FT	FEET
GAL	GALLON(S)
GALV	GALVANIZED
GPM	GALLONS PER MINUTE
HB	HOSE BIBB
HP	HORSEPOWER
HTR	HEATER
H2O	WATER
HW	HOT WATER
HZ	HERTZ
INV	INVERT
IN	INCHES
LAT	LEAVING AIR TEMPERATURE
MAX	MAXIMUM
MECH	MECHANICAL
MIN	MINIMUM
MOBD	MOTORIZED OPPOSED BLADE DAMPER
NC	NORMALLY CLOSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OA	OUTSIDE AIR
OH	OVERHEAD
PD	PRESSURE DROP
PLBG	PLUMBING
PRESS	PRESSURE
PSI	POUNDS PER SQUARE INCH, GAUGE
PVC	POLYVINYL CHLORIDE
RA	RETURN AIR
REFRIG.	REFRIGERATION
RPM	REVOLUTIONS PER MINUTE
SA	SUPPLY AIR
SHT	SHEET
SP	STATIC PRESSURE
SPEC	SPECIFICATION
T/A	THROW AWAY (FILTERS)
TEMP	TEMPERATURE
TSH	TOTAL SENSIBLE HEAT
TYP	TYPICAL
UG	UNDERGROUND
UL	UNDERWRITER'S LABORATORIES
V	VENT
VTR	VENT THRU ROOF
WB	WET BULB
W/	WITH
W/O	WITHOUT

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STATE OF TEXAS
AARON T. LOVELOCK
145763
LICENSED PROFESSIONAL ENGINEER
05/15/2025.

WILLIAMSON COUNTY
Jail North Dishwasher Exhaust
306 W 4th Street
Georgetown, TX 78626

Drawn	CZE
Checked	CZE
Date	05-15-2025
Project No.	240797
Revisions	

SHEET TITLE

MECHANICAL SYMBOLS AND ABBREVIATIONS

SHEET NO.

M000

3 OF 14

EXISTING PANEL LK3

LOCATION:	ELEC J1123		VOLTAGE:	208/120	V		KAIC:	EXISTING	BUSSING SHALL BE FULLY RATED
MOUNTING:	SURFACE		PHASE:	3	P / 4W		CODES:	0=EQPT, 1=RCPT, 2=LTG, 3=A/C, 4=HEAT	
ENCLOSURE:	NEMA 1	STYLE: P1	BUSSING:	250	A			5=CONTINUOUS MOTORS, 6=LRGST MOTOR	
BRKR MTG:	BOLT-ON	(REF: SIEMENS)	MCB:	200	A	ACCESSORIES:		42 SPACE	
BREAKERS:	75 DEGREE TERMINALS		MLO:		A				

CODE	BRKR	CIRCUIT USE	CKT	LOAD	A	B	C	LOAD	CKT	CIRCUIT USE	BRKR	CODE
	50/1	*SPARE*	1		X				2	*GFCI UNDER HOOD*	20/2	
	50/1	*SPARE*	3			X			4			
	50/1	*SPARE*	5				X		6	*GFCI UNDER HOOD*	20/2	
			7		X				8			
	50/3	*SPARE*	9			X			10	*SPARE*	20/1	
			11				X		12	*SPARE*	20/1	
	20/2	*GFCI UNDER HOOD*	13		X				14	*GFCI UNDER HOOD*	20/2	
			15			X			16			
	20/1	*SPARE*	17				X		18	*SPARE*	20/1	
	20/2	*MIXER*	19		X				20	*MIXER*	20/2	
			21			X			22			
	20/1	*RECEPTACLES*	23				X		24	*SPARE*	20/1	
	20/1	*RECEPTACLES*	25		X				26	*OFFICE SPLIT*	30/2	
			27			X			28			
	20/3	*SPARE*	29				X		30	*SPARE*	20/1	
			31		X				32	*SPARE*	20/1	
	20/2	*GFCI UNDER HOOD*	33			X			34	*GFCI UNDER HOOD*	20/2	
			35				X		36			
	20/1	*SPARE*	37		X				38	*SPARE*	20/1	
	20/1	*SPARE*	39			X			40	*SPARE*	30/2	
5	20/1	**DISHWASHER EXHAUST FAN (NOTE 1)**	41	**1,176**			X		42			

	EQPT VA	RCPT VA	LTG VA	AC/HEAT VA	MOTORS	CONN VA	FTL VA	PANEL VA	PHASE AMP
PHASE A	0	0	0	0	0	0		0	0
PHASE B	0	0	0	0	0	0		0	0
PHASE C	1176	0	0	0	0	1176		1176	10
TOTAL	1176	0	0	0	0	1176		1176	

PANEL DESIGN KVA:	1.18	PANEL SUBTOTAL:	3	AMPS
RESERVE CAPACITY KVA:	0.24	RESERVE CAPACITY:	0	AMPS
TOTAL KVA:	1.41	PANEL DESIGN CURRENT:	4	AMPS

NOTES:

1. PROVIDE NEW CIRCUIT USING EXISTING CIRCUIT BREAKER.

2 / ME301 PARTIAL ONE-LINE DIAGRAM
NOT TO SCALE

LOAD ANALYSIS:

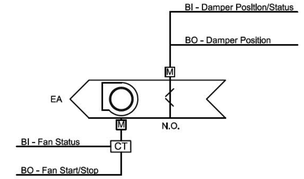
ADDITION OF NEW EXHAUST FAN INCREASES LOAD ON PANEL "LK3" BY 3A. EXISTING PANEL HAS SUFFICIENT CAPACITY FOR NEW LOAD.

FAN SCHEDULE

MARK	TYPE	MANUFACTURER & MODEL	SERVICE	CFM	S.P. ("WG)	MAX. BHP	H.P.	V/PH/MCA/MOCP	MAX. SONES	DRIVE	INTERLOCK	NOTES
EF-1	UPBLAST	GREENHECK CUE-100HP-VG	DISHWASHER EXHAUST	400	1.00	0.17	1/2	115/1/8.2/15	9.4	DIRECT	DISHWASHER	1,2

FAN SCHEDULE KEYED NOTES:

1. PROVIDE MANUFACTURER'S STANDARD MOTOR-RATED SWITCH, BACKDRAFT DAMPER, HOOD HASPS, AND INSECT SCREEN.
2. INTERLOCK WITH DISHWASHER.



1 / ME301 WALL-MOUNTED UPBLAST EXHAUST FAN SCHEMATIC
NOT TO SCALE — EF-1

CONTROL:
FAN SHALL BE INTERLOCKED WITH ASSOCIATED DISHWASHER AND HAVE START/STOP CAPABILITY THROUGH DDC SYSTEM. FAN SHALL RUN CONTINUOUSLY WHEN ASSOCIATED DISHWASHER IS ENERGZIED AND SHALL SHUT DOWN WHEN ASSOCIATED DISHWASHER IS DE-ENERGIZED.

MOTORIZED DAMPER SHALL BE INTERLOCKED WITH DISHWASHER EXHAUST FAN. DAMPER SHALL BE OPEN WHEN FAN IS ON. DAMPER SHALL CLOSE WHEN FAN IS OFF.

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SHEET TITLE
SCHEDULES, CONTROLS AND ONE-LINE DIAGRAM

SHEET NO.
ME301

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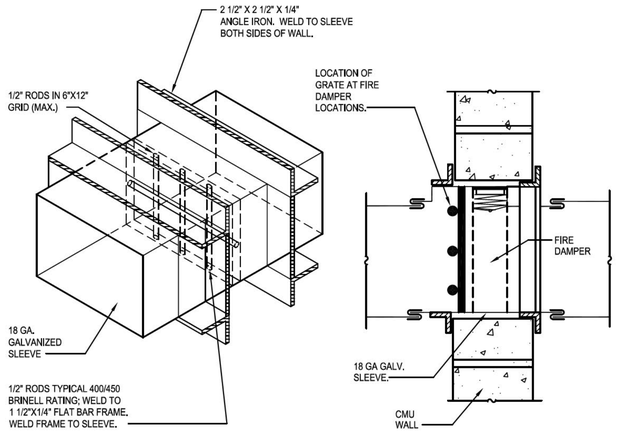
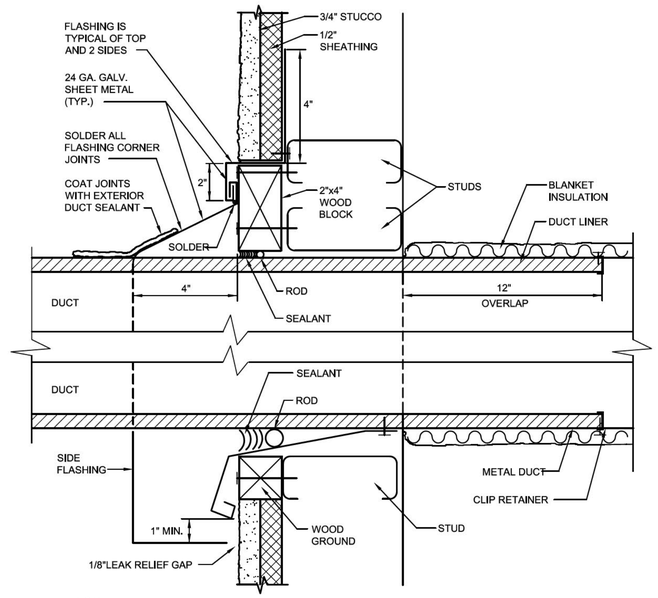
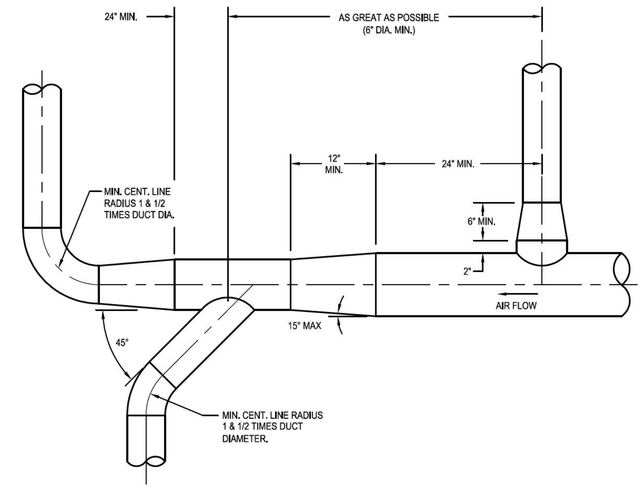


1 ME501 **TYPICAL SECURITY FIRE DAMPER**
NOT TO SCALE

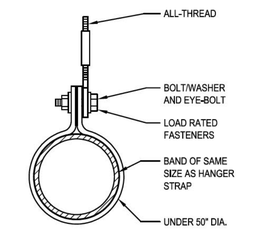


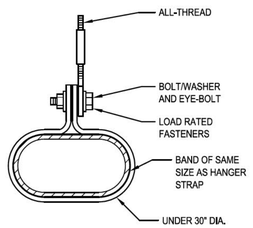
NOTE:
PAINT DUCT AND FLASHING PER ARCHITECT'S INSTRUCTIONS

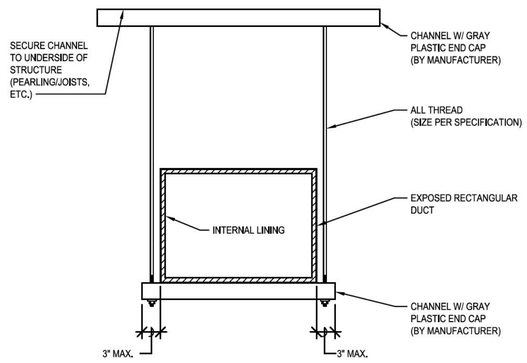
2 ME501 **DUCT PENETRATION OF WALL**
NOT TO SCALE

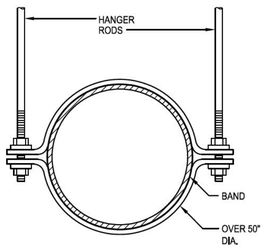


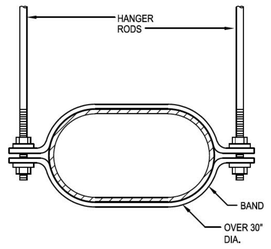
3 ME501 **ROUND DUCT DETAIL**
NOT TO SCALE











4 ME501 **EXPOSED DUCT HANGER DETAIL**
NOT TO SCALE

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SHEET TITLE
DETAILS

SHEET NO.
ME501
14 OF 14

SPECIFICATIONS MANUAL FOR:

Williamson County – Criminal Justice Facility Dishwasher Exhaust

306 W 4th Street
Georgetown, Texas

May 15, 2025

1344 S. Flores, Ste. 101, San Antonio, TX 78204 | P: 210.447.6100 | TBPE No. F-9357

TABLE OF CONTENTS

END OF TABLE OF CONTENTS

SECTION 01 10 00

SUMMARY

PART 1 - GENERAL

1.1 PROJECT IDENTIFICATION WILLIAMSON COUNTY

Facility and Project Scope identified in Contract.

1.2 WORK BY OWNER

A. Concurrent work by Owner or others: Owner reserves the right to conduct minor work with his own forces or separate contractors during the construction. Work will be coordinated with the contractor along the general demarcation line shown on the civil drawings.

1.3 OWNER SUPPLIED PRODUCTS

A. Owner will arrange for and deliver Owner-furnished items.

B. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.

C. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.

D. Owner will furnish Contractor the earliest possible delivery date for Owner- furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.

E. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.

F. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

A. Access to Site: Contractor will have unrestricted access to site. Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.5 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by inference where a colon (:) is used within sentences or phrases. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, 'Provide tile' means 'Contractor shall provide tile.'

1.6 CONTRACTOR

A. Permits and Fees: Apply for, obtain, and pay for permits, if applicable, fees, and utility company back charges required to perform the work. Contractor is responsible for contacting the local service providers (municipality, water, electric, and communications). Refer to plans for additional information. All inspections at site will be conducted by County and other Authorities Having Jurisdiction staff.

B. Codes: Comply with applicable codes and regulations indicated on coversheet of Construction Drawings. Submit copies of inspection reports, notices, and similar communications to Owner.

C. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.

D. Existing Conditions: Notify Owner of existing conditions differing from those indicated on the drawings. Do not remove or alter structural components without prior written approval of the Architect.

E. Coordination:
   1. Coordinate the work of all trades.
   2. Prepare coordination drawings for areas above ceilings where close tolerances are required between building elements and mechanical and electrical work.
   3. Verify location of utilities and existing conditions prior to beginning work.

F. Installation Requirements, General:
   1. Inspect substrates and report unsatisfactory conditions in writing.
   2. Do not proceed until unsatisfactory conditions have been corrected.
   3. Take field measurements prior to fabrication where practical. Form to required shapes and sizes with true edges, lines and angles. Provide inserts and templates as needed for work of other trades.
   4. Install materials in accordance with Manufacturer's instructions and approved submittals.
   5. Install materials in proper relation with adjacent construction and with proper appearance.
   6. Restore units damaged during installation. Replace units which cannot be restored at no additional expense to the Owner.
   7. Refer to additional installation requirements and tolerances specified under individual specification sections.

G. Definitions:
   1. Provide: Furnish and install, complete with all necessary accessories, ready for intended use. Pay for all related costs.
   2. Reviewed: Review of items submitted. Not a limitation or release for compliance with the Contract Documents or regulatory requirements. Refer to limitations of 'Reviewed' in General and Supplementary Conditions.

H. Intent: Drawings and specifications are intended to provide the basis for proper completion of the work suitable for the intended use. Anything not expressly set forth, but which is reasonable implied or necessary for proper performance of the project shall be included.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 14 00

WORK RESTRICTIONS

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 CONTRACTOR USE OF PREMISES

A. The Contracting Officer and/or Contracting Officer's Representative will conduct a pre-construction survey with the Contractor to review and document the existing conditions surrounding the project premises prior to the beginning of any construction activity.

B. The Contractor shall limit use of the premises to the work in areas indicated, to allow for Owner occupancy.Retain the following subparagraphs that apply. Revise as required to suit project conditions.

1. Confine operations at the site to areas indicated. Do not disturb portions of the site beyond the areas in which Work is indicated. All work shall be conducted after hours and shall be scheduled with the building manager and the contracting officer.
2. All contractor personnel shall have security background checks and fingerprint identification. Fingerprinting shall be the responsibility of the general contractor.
3. Building entrance location shall be designated by the contracting officer and entrance to the building shall require identification badge with picture.
4. Keep driveways and entrances serving the premises clear and available at all times to the Owner, Owner employees and visitor’s. Do not use these areas for parking or storage of materials.
5. Schedule deliveries to minimize space and time requirements for storage of material and equipment on site.
6. Maintain existing building in a safe and weathertight condition throughout the construction period. Repair damage caused by construction operations. Take precautions to protect the building, its occupants and the public during the construction period.
7. Keep all areas free from accumulation of waste material, rubbish, construction debris and construction materials.Retain one of the two following subparagraphs, or delete if storage space is shown on the drawings.
8. Storage space on the premises will be limited. Location of storage areas shall be coordinated with the agency’s designated representative.
9. Existing materials and equipment that are removed as part of the construction operations, and that are not reused or designated to be salvaged as owner or other's property, shall become the property of the Contractor and shall be removed from the site. Storage or sale of excess salvageable materials and equipment is not permitted on site.
10. Pollution producing equipment shall not be located near air intakes where airborne smoke or fumes could be drawn into the building.

1.3 OWNER OCCUPANCY

A. The Owner will occupy the site and the existing building during the entire period of construction. Cooperate with the Owner's representatives during construction operations to

minimize conflicts and facilitate Owner usage. Perform the Work in a manner that does not interfere with the Owner's operations.

1.4 WORKING HOURS

A. The facility will remain occupied and fully operational during the construction. Owner personnel will occupy the building 24 hours per day, 7 days a week.

B. Contractor's General Working Hours: The Contractor working hours shall be generally established to occur between the hours of 7:00 AM to 6:00 PM.

C. Electrical shutdown work shall be scheduled at least ten (10) working days in advance and coordinated with the Owner’s Authorized Representative.

1.5 SECURITY: All personnel entering or working on Federal Property will be screened and checked for criminal history and proper immigration status. Personnel who do not meet these minimum standards will not be allowed on the property.

A. The General Contractor must submit the following for personnel to work at the facility:
   1. Individual’s full name
   2. Date of birth (DOB)
   3. Social Security Number
   4. Drivers Licenses Number and/or State Identification Number

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SCHEDULE OF VALUES

A. Submit printed schedule on Owner provide form or electronic media.

B. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with Continuation Sheets
      b. Submittals Schedule
      c. Contractor's Construction Schedule
   2. Submit the Schedule of Values to the County Architect in duplicate no later than seven days before the date scheduled for submittal of initial Applications for Payment.

C. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section. Identify separately site mobilization, bonds and insurance, and a breakdown of the General Contractors general conditions.
   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location
      b. Name of County Architect
      c. Williamson County (“Wilco”) project number
      d. Contractor's name and address
      e. Date of submittal
   2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
      a. Related Specification Section or Division
      b. Description of the Work
      c. Change Orders (numbers) that affect value
      d. Allowances (numbers) per bid proposal
      e. Dollar value
         1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent
   3. Provide a breakdown of the Contract Sum (labor & materials) in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
   4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
   5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
      a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
   6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
   7. Provide separate line items in the Schedule of Values for each Allowance per bid proposal.

8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.
10. Provide any additional information as set forth in the UGC.

1.2 APPLICATIONS FOR PAYMENT

A. Submit two copies of each application to County Architect for review, 7 days prior to Payment Application Time.

B. Each monthly Application for Payment shall be consistent with previous applications and payments as certified by Williamson County Project Manager, County Architect, Williamson County Senior Director and paid for by Owner.
    1. Initial Application for Payment, Application for Payment at Substantial Completion, and final Application for Payment require additional documentation.

C. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

D. Payment Application Forms: Use forms provided by Williamson County for Applications for Payment.

E. Application Preparation: Complete every entry on form. County Architect and Williamson County Project Manager will return incomplete applications without action.
    1. Entries shall match data on the Schedule of Values. Use updated schedule if revisions were made.
    2. Include amounts of Change Orders approved before last day of construction period covered by application.
    3. Submit Contractor’s Affidavit of Payment of Debts and Claims – Monthly Progress Payment
    4. Submit updated two construction schedules with each Application for Payment.

F. Transmittal: Submit 5 signed original copies of each Application for Payment to County Architect by a method ensuring receipt within 24 hours.
    1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
    1. List of subcontractors
    2. Schedule of Values
    3. Contractor's Construction Schedule
    4. Products list
    5. Schedule of unit prices
    6. Submittals Schedule
    7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work

H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   1. Updated final statement, accounting for final changes to the Contract Sum
   2. Owner provided document, "Contractor's Affidavit of Payment of Debts and Claims – Final Payment"
   3. Owner provided document, "Consent of Surety to Final Payment"
   4. Evidence that claims have been settled
   5. Final liquidated damages settlement statement if applicable.
   6. Buy America form D-9-USA 1 or it equivalent.
   7. If required, a close-out Change Order.
   8. Provide any additional information as set forth in UGC.

J. Substantiating Data: When County Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Affidavits attesting to off-site stored products.
   2. Construction progress schedules, revised and current.

1.3 CHANGE PROCEDURES

A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. The County Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions.

C. Owner-Initiated Proposal Requests: County Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Proposal Requests issued by County Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
   2. Within 10 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

D. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to County Architect.
   1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
   2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   3. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.
   4. Include costs of labor and supervision directly attributable to the change.
   5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
   6. Use Williamson County approved Proposal Requests.
      a. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.

1.4 CHANGE ORDER PROCEDURES

A. On approval of a Proposal Request, Owner will issue a Change Order for signatures of Contractor and County Architect on Owner’s appropriate form.
   1. Execution of Change Orders: Owner shall issue Change Orders for signatures of parties as provided in Conditions of the Contract.

B. Correlation Of Contractor Submittals:
   1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
   2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
   3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the County Architect/Engineer, it is not practical to remove and replace the Work, the County Architect/Engineer and/or Owner will direct appropriate remedy or adjust payment.

C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of County Architect/Engineer and/or Owner.

D. Defective Work will be partially repaired to instructions of County Architect/Engineer and/or Owner and unit sum/price will be adjusted to new sum/price at discretion of County Architect/Engineer and /or Owner.

E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of County Architect/Engineer and/or Owner to assess defects and identify payment adjustments is final.

G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from transporting vehicle.
   4. Products placed beyond lines and levels of required Work.
   5. Products remaining on hand after completion of the Work.
   6. Loading, hauling, and disposing of rejected products.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 PRODUCT LIST:

A. Within 30 days after date of Contract, submit to Architect a digital copy of complete list of products and materials which are proposed for installation.

B. Prepare list on basis of each Specification section.

C. For products specified under reference standards, include with listing of each product:
   1. Name and address of manufacturer.
   2. Trade name.
   3. Model or catalog designation.
   4. Manufacturer's data, including performance and test data, reference standards.

1.2 CONTRACTOR'S OPTIONS:

A. For products specified only by reference standards, select any product meeting standards, by any manufacturer.

B. For products specified by naming several products or manufacturers, select any product and manufacturer named.

C. For products specified by naming only one product and manufacturer, there is no option, unless a substitution is approved as specified below.

1.3 SUBSTITUTIONS:

A. During Bidding, no substitution requests will be considered.

B. Within 30 days after date of Contract, Architect will consider formal requests from Contractor for substitutions of products in place of those specified. No request for substitutions will be considered after this date.

C. Submit an electronic copy of request for substitution. Include in substitution:
   1. Data substantiating compliance of proposed substitution with Contract documents.
   2. For products:
      a. Product identification, including manufacturer’s name and address.
      b. Manufacturer’s literature, including product description, performance and test data and reference standards.
      c. Samples, if applicable.
      d. Name and address of similar projects on which product was used and date of installation.
   3. For construction methods:
      a. Detailed written descriptions of proposed method.
      b. Complete drawings illustrating methods or revisions.

4. Itemized comparison of proposed substitution with product or method specified.
5. Data relating to changes in construction schedule.

D. In making request for substitution, Bidder/Contractor represents:
1. He has personally investigated proposed product or method and determined that it is equal or superior in all respects to that specified.
2. He will provide same guarantee for substitution as for product or method specified.
3. He will coordinate installation of accepted substitution into work, making such changes as may be required for work to be complete in all respects.
4. He waives all claims for additional costs related to substitution which subsequently becomes apparent

E. Substitutions will not be considered if:
1. They are indicated or implied on show drawings or product data submittals without formal request as submitted in accordance with *Article 1.3* of this Section.
2. Acceptance will require substantial revision of Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements.
1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.

SUBSTITUTION REQUEST

PROJECT: _____ PROJECT NO.: _____

TO: Wilco Construction Project Manager FROM: CONTRACTOR/BIDDER

_____ _____

_____ _____

CONTRACTOR (BIDDER) HEREBY REQUESTS ACCEPTANCE OF THE FOLLOWING PRODUCT OR SYSTEMS AS A SUBSTITUTION IN ACCORD WITH PROVISIONS OF DIVISION ONE OF THE SPECIFICATIONS:

1. SPECIFIED PRODUCT OR SYSTEM:
   Substitution request for (Generic Description): _____

   Specification Section No.: _____Article(s) _____Paragraph (s) _____

2. SUPPORTING DATA:
   Product data for proposed substitution is attached (description of product, reference standards, performance, and test data).

3. QUALITY COMPARISON:

	SPECIFIED PRODUCT	SUBSTITUTION
Name brand:	_____	_____
Catalog No.	_____	_____
Manufacturer:	_____	_____
Vendor:	_____	_____
Significant Variations:		
	_____	_____
	_____	_____

Maintenance Service Available: _____Yes _____No

Spare Part Source: _____

4. PREVIOUS INSTALLATIONS:
   Identification of similar projects on which proposed substitution was used:

   Project: _____ Architect: _____

   Address: _____ Owner: _____

   _____ Date Installed: _____

   _____

5. REASON FOR NOT GIVING PRIORITY TO SPECIFIED ITEMS:

   _____

   _____

   _____

6. EFFECT OF SUBSTITUTION:

Proposed substitution affects other parts of Work: _____No _____Yes (If yes, explain)

_____

_____

Substitution changes Contract Time: _____No _____Yes Add/Deduct _____days.

Substitution requires dimensional revision or redesign of structure or M & E Work:

_____No _____Yes (If yes, attach compete data)

Saving or credit to Owner, if any, for accepting substitution: $_____.

Extra cost to Owner, if any, for accepting substitution: $_____.

7. CONTRACTOR'S (BIDDER'S) STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENT:

   I/we:
   ____have investigated the proposed substitution.
   ____believe that it is equal or superior in all respects to specified product, except as stated above.
   ____will provide the same warranty as specified for specified product.
   ____have included complete cost data and implications of the substitution.
   ____will pay redesign and special inspection costs caused by the use of this product.
   ____will pay additional costs to other contractors caused by the substitution.
   ____will coordinate the incorporation of the proposed substitution in the Work.
   ____will modify other parts of the work as needed, to make all the work complete and functioning.
   ____waive future claims for added cost to Contract caused by the substitution.

Contractor (Bidder): _____ Date: _____

By: _____

Answer all questions and complete all blanks - use "N/A" if not applicable.

ARCHITECT REVIEW AND ACTION

_____Resubmit substitution request:

_____Provide more information in following categories.

_____

_____Sign Contractor's (Bidder's) Statement of Conformance.

_____Substitution accepted.

_____Substitution is accepted with the following comments.

_____

_____

_____Substitution not accepted.

_____Substitution Request received too late.

_____ _____

Architect / Engineer of Record Date

END OF SECTION

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Owner through the Owner's Representative (OR) can modify the construction contract.

1.2 CONTRACT CHANGES

A. The UGC (Uniform General Conditions), Article 11 states that the Owner may order changes in the Work within the general scope of the Contract, consisting of additions, deletions or other changes. If such changes cause an increase or decrease in the Contract Sum or Contract Time, an equitable adjustment may be made and confirmed in writing in the form of a Change Order.

1. A desired Contract modification is identified as a Contract Revision that will generally only be issued by the OR or A/E in accordance with the UGC. The Contract Revision is priced by the Contractor, then evaluated by the OR and A/E and approval by the Owner. A Change Order may contain one or more approved Contract Revisions. After the Change Order incorporating one or more Contract Revisions into the Contract is approved, the Contractor can add the work to the next payment application. It is necessary that all Contract Revisions be recorded and numbered in sequence. The OR maintains a log of all Contract Revisions and their status. Any suggestion of a change, including possible claims, must be in the log and numbered.
2. A Contract Revision will be issued to the Contractor by the Owner.
   Contractor's Proposal - The Contractor will complete the Contract Revision and return the original to the OR, with a copy to the A/E, along with a detailed cost breakdown. The cost breakdown shall consist of itemized pricing of easily identifiable components such as linear footage, square footage, cubic yardage, pounds, etc. This breakdown shall also be broken down by labor and materials. In addition, all subcontractor pricing shall be broken down using the same format. This detailed cost breakdown makes it possible to evaluate the Contractor's cost proposal. If the Contractor requests a time extension for the changed work, adequate justification must be provided to prove the impact on the accepted construction schedule (refer to UGC Article 9 and Section 01 32 00).
   Owner's Action - Upon receipt of the Contract Revision, the OR and A/E will review the Contractor's cost and time proposals and make a decision whether to proceed with the Contract Revision, reject it, or negotiate all or certain items with the Contractor. The OR will notify the Contractor of the decision taken and will provide copies of the decision to the A/E and Project Inspector. Approval will authorize the Contractor to proceed with the work. Approved Contract Revisions will be incorporated into a subsequent Change Order.
3. The cost of increased or decreased work will be calculated according to Uniform General and Supplementary Conditions.
4. Interim Change Authorization (ICA) - When changes are done by ICA, the Owner's Project Manager will define the scope of work in a Contract Revision which will also serve as the Contractor's Notice to Proceed. This work, in effect, becomes cost reimbursable Work, which will be subject to careful, detailed record keeping. The OR will carefully verify the manpower, supplies and equipment used on the Contract Revision so that the Owner gets the benefit of economic and efficient operation. Any overhead or fee markups on the cost of the direct work will be as agreed between the

OR and the Contractor and set forth in the ICA, but in no case will they exceed the maximums established in the UGC.

When the scope of the work requested under an ICA has been completed, all ICA Statements will be consolidated and transmitted to the Owner in the same manner as a regular Contract Revision.

As soon as possible after the work is complete, the price will be agreed upon and incorporated into a Change Order.

Lump Sum Proposal - Lump sum proposals for Work under an ICA can be acceptable when it is not feasible to itemize the elements of work. In general, Lump Sum proposals should be avoided except for small items of work.

5. Unilateral Change Order (ULCO) - The ULCO will be used sparingly and may be used only on the approval of the OR.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Provide project superintendent and other supervisory personnel required for proper performance of the work.
2. Submit list of subcontractors' names, phone numbers and trade work.
3. Participate in a pre-construction meeting at a time and place determined by the Owner for the purpose of identifying responsibilities of the Owner's and Architect's personnel and explanation of administrative procedures.
4. Schedule and conduct monthly meetings, distribute meeting Minutes.
5. Schedule and conduct other meetings as necessary, distribute meeting Minutes.
6. Owner to schedule and conduct other meetings as necessary, the Owner will distribute meeting Minutes.
7. Preparation of Contractor's Construction Schedule.
8. Preparation of the Schedule of Values.
9. Installation and removal of temporary facilities and controls.
10. Preparation of the Submittal Review Schedule.
11. Delivery and processing of submittals.
12. Progress meetings.
13. Preinstallation conferences.
14. Project closeout activities.
15. Startup and adjustment of systems.
16. Project closeout activities.
17. Submit bar chart progress schedule, updated monthly.
18. Prepare submittal schedule coordinated with progress schedule.
19. Submit schedule of values, divided so as to facilitate payments to subcontractors, on forms acceptable to the Owner. Schedule, when approved, will be used as the basis for the Contractor's Application for payment.
20. Submit schedule of required tests.
21. Perform all field engineering, layout, and surveying required for layout of project.
22. Submit and post a list of emergency telephone numbers and addresses for individuals to be contacted in case of emergency.
23. Record drawings and specifications to be maintained and annotated by contractor as work progresses to record actual construction, and be turned over to the Architect at substantial completion. See Section 01 70 00 for detailed requirements.
24. Submit payment request procedures.
25. Perform quality control during installation.
26. Clean and protect the work.

C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

D. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

H. After Owner occupies the premises any access to complete remaining Work or correct defective Work must be coordinated with the Owner's representative in order to minimize disruption of Owner's activities.

1.2 CONSTRUCTION LAYOUT

A. The General Contractor shall include in his bid the cost for providing all construction staking by a Registered Public Surveyor (Surveyor) licensed by Texas Board of Professional Land Surveyors who can demonstrate experience and competence to perform the work described. The grades, spot elevations, dimensions radii, flow line elevations, existing benchmarks, excavation and site grading will be indicated on the plans. In the event that discrepancies are noted in the plans by the Contractor and/or the Surveyor, the Architect and/or Engineer of Record shall be notified and the discrepancies shall be resolved prior to proceeding with the Work. The Surveyor shall supervise the layout work and establish at least three (3) separate permanent bench marks, to which easy access may be had during the progress of the work, to determine and verify lines and grades.

B. Under the supervision of the Surveyor, the layout of the work shall be made from the surveyor-established base lines, utility alignments, curb faces, key trees, bench marks and all other control lines as indicated on the plans; and the Contractor shall be responsible for all measurements in connection therewith as specified and as indicated on the plans.

C. Contractor shall be responsible for having the Surveyor **verify that elevations of form work.** The Surveyor shall return a second time to **verify site grading, sidewalk elevations, rough grading next to buildings, concrete curb elevations, base material elevations prior to paving.** All surveying work shall comply with the elevations, lines and grades shown on the plans and **provide a written report and large size (22” x 34”) drawings indicating findings** to the Architect and/or Engineer of Record for consideration and response prior to placing concrete, placing asphalt or install landscaping. Contractor shall not proceed further without Surveyor’s Report / Drawings and the contractor shall be responsible for making the required corrections prior to continuing the Work. No extra charge or compensations will be allowed due to differences between actual dimensions and the measurements indicated on the drawings.

D. Employ Land Surveyor registered and acceptable to the Owner.

E. Locate and protect survey control and reference points. Promptly notify Architect/Engineer of discrepancies discovered.

F. Control datum for survey is that established by Owner provided survey.

G. Verify set-backs and easements; confirm drawing dimensions and elevations.

H. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

I. Submit copy of site drawing signed by Land Surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.

J. Maintain complete and accurate log of control and survey work as Work progresses.

K. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

L. Promptly report to Architect/Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.

M. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

1.3 PRECONSTRUCTION MEETING

A. The Owner's Representative will schedule a pre-construction conference and organizational meeting at the Project Site or other convenient location after execution of the Agreement and prior to commencement of construction activities. The Owner's Representative will conduct the meeting to review responsibilities and personnel assignments.

B. Attendees shall include: The Owner, Architect/Engineer and their consultants, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. The Agenda shall: Discuss items of significance that could affect progress including such topics as:
1. Tentative construction schedule
2. Critical Work sequencing
3. Designation of responsible personnel
4. List of Subcontractors, trade work, names and phone numbers
5. Procedures for processing field decisions and Change Orders
6. Procedures for processing Applications for Payment
7. Distribution of Contract Documents
8. Submittal of Shop Drawings, Product Data and Samples
9. Preparation of record documents
10. Use of the premises
11. Office, Work, and Storage Areas
12. Equipment deliveries and priorities
13. Safety procedures
14. First Aid
15. Security
16. Housekeeping
17. Working hours

D. The Owner's Representative will record Minutes and distribute copies within five days after meeting to participants, with copies to contractor and those affected by decisions made.
1. General Contractor will distribute Minutes to others.

1.4 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum bi-weekly intervals.
   1. Coordinate dates of meetings with Architect and Williamson County Project Manager.
   2. Prepare Contractor's Application for Payment (CAP) on Williamson County form. Architect shall provide forms required for payment submittal.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Job superintendent, major subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
   1. Review of Minutes of previous meetings
   2. Review of Work progress
   3. Field observations, problems, and decisions
   4. Identification of problems impeding planned progress
   5. Review of submittals schedule and status of submittals
   6. Review of off-site fabrication and delivery schedules
   7. Maintenance of progress schedule
   8. Corrective measures to regain projected schedules
   9. Planned progress during succeeding work period
   10. Coordination of projected progress
   11. Maintenance of quality and work standards
   12. Effect of proposed changes on progress schedule and coordination
   13. Other business relating to Work

E. Record Minutes and distribute copies within three days after meeting to participants, with copies to Architect/Engineer, Owner, and those affected by decisions made.

1.5 PRE-INSTALLATION MEETINGS

A. When required in individual specification sections, convene pre-installation meetings at Project site prior to commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Notify Architect/Engineer and Owner 14 days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of installation, preparation and installation procedures.
   2. Review coordination with related work.
      a. Contract documents
      b. Options
      c. Related Change Orders
      d. Purchases
      e. Deliveries
      f. Shop Drawings, Product Data and Quality Control Samples
      g. Possible Conflicts
      h. Compatibility Problems
      i. Time Schedules
      j. Weather Limitations
      k. Manufacturer's Recommendations

l. Compatibility of Materials
m. Acceptability of Substrates
n. Temporary Facilities
o. Space and Access Limitations
p. Governing Regulations
q. Safety
r. Inspection and Testing Requirements
s. Recording Requirements
t. Protection

E. Record Minutes and distribute copies within three days after meeting to participants, with copies to Architect/Engineer, Owner, and those affected by decisions made.
1. Do not proceed if the conference cannot be successfully concluded.
2. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.6 COORDINATION MEETINGS

A. Conduct project coordination meetings at regularly scheduled times convenient for all parties involved. Project Coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and specific pre-installation conferences.

B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.

C. Record meeting decisions or action and distribute copies to everyone in attendance and to others affected by those decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination Drawings.
   2. Administrative and supervisory personnel.
   3. Project meetings.
   4. Requests for Interpretation (RFIs).

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

C. Related Sections include the following:
   1. Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's Construction Schedule.
   2. Preparation of the Schedule of Values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Pre-installation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.
   9. Project closeout activities.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
   1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
      a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      b. Indicate required installation sequences.
      c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect/Engineer for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
   2. Sheet Size: At least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
   3. Number of Copies: Submit three opaque copies of each submittal. Architect/Engineer will return one copy.
      a. Submit five copies where Coordination Drawings are required for operation and maintenance manuals. Architect/Engineer will retain two copies; remainder will be returned.
   4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 15-days days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at

Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
   1. Include special personnel required for coordination of operations with other contractors.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect/Engineer of scheduled meeting dates and times.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect/Engineer, within 3-days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect/Engineer, but no later than 15-days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
   1. Attendees: Authorized representatives of Owner, Architect/Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Tentative construction schedule.
      b. Phasing.
      c. Critical work sequencing and long-lead items.
      d. Designation of key personnel and their duties.
      e. Procedures for processing field decisions and Change Orders.
      f. Procedures for RFIs.
      g. Procedures for testing and inspecting.
      h. Procedures for processing Applications for Payment.
      i. Distribution of the Contract Documents.
      j. Submittal procedures.
      k. LEED requirements.
      l. Preparation of Record Documents.
      m. Use of the premises and existing buildings (when applicable).
      n. Work restrictions.
      o. Owner's occupancy requirements.
      p. Responsibility for temporary facilities and controls.
      q. Construction waste management and recycling.
      r. Parking availability.
      s. Office, work, and storage areas.
      t. Equipment deliveries and priorities.

u. First aid.
v. Security.
w. Progress cleaning.
x. Working hours.

3. Minutes: Architect/Engineer will record and distribute meeting minutes.

C. Pre-installation Conferences: Conduct a Pre-installation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect/Engineer of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. The Contract Documents.
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Review of mockups.
   i. Possible conflicts.
   j. Compatibility problems.
   k. Time schedules.
   l. Weather limitations.
   m. Manufacturer's written recommendations.
   n. Warranty requirements.
   o. Compatibility of materials.
   p. Acceptability of substrates.
   q. Temporary facilities and controls.
   r. Space and access limitations.
   s. Regulations of authorities having jurisdiction.
   t. Testing and inspecting requirements.
   u. Installation procedures.
   v. Coordination with other work.
   w. Required performance results.
   x. Protection of adjacent work.
   y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner and Architect/Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
        1) Review schedule for next period.
    b. Review present and future needs of each entity present, including the following:
        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site utilization.
        8) Temporary facilities and controls.
        9) Work hours.
        10) Hazards and risks.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of correction of deficient items.
        14) Field observations.
        15) RFIs.
        16) Status of proposal requests.
        17) Pending changes.
        18) Status of Change Orders.
        19) Pending claims and disputes.
        20) Documentation of information for payment requests.
3. Minutes: Architect/Engineer will record and distribute to Contractor the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
    a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

E. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and Pre-installation conferences.
1. Attendees: In addition to representatives of Owner and Architect/Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule

revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

c. Review present and future needs of each contractor present, including the following:
   1) Interface requirements.
   2) Sequence of operations.
   3) Status of submittals.
   4) Deliveries.
   5) Off-site fabrication.
   6) Access.
   7) Site utilization.
   8) Temporary facilities and controls.
   9) Work hours.
   10) Hazards and risks.
   11) Progress cleaning.
   12) Quality and work standards.
   13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
   1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
   2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI (Sample Attached): Include a detailed, legible description of item needing interpretation and the following:
   1. Project name.
   2. Date.
   3. Name of Contractor.
   4. Name of Architect/Engineer.
   5. RFI number, numbered sequentially.
   6. Specification Section number and title and related paragraphs, as appropriate.
   7. Drawing number and detail references, as appropriate.
   8. Field dimensions and conditions, as appropriate.
   9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   10. Contractor's signature.
   11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
      a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Hard-Copy RFIs: Sample attached at end of this Section.
   1. Identify each page of attachments with the RFI number and sequential page number.

D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
   1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Architect/Engineer's Action: Architect/Engineer will review each RFI, determine action required, and return it. Allow seven working days for Architect/Engineer's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
   1. The following RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for coordination information already indicated in the Contract Documents.
      d. Requests for adjustments in the Contract Time or the Contract Sum.
      e. Requests for interpretation of Architect/Engineer's actions on submittals.
      f. Incomplete RFIs or RFIs with numerous errors.
   2. Architect/Engineer's action may include a request for additional information, in which case Architect/Engineer's time for response will start again.
   3. Architect/Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."
      a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect/Engineer in writing within 10-days of receipt of the RFI response.

F. On receipt of Architect/Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect/Engineer within 7-days if Contractor disagrees with response.

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log biweekly. Software log with not less than the following:
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect/Engineer.
   4. RFI number including RFIs that were dropped and not submitted.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect/Engineer's response was received.
   8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
   9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 31 50

PROJECT MEETINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. General Project Meeting Information.

B. Pre-Construction Meeting.

C. Progress Meetings.

D. Pre-Installation Meetings.

E. Lockset Hardware/Key Conference.

1.2 RELATED SECTIONS:

A. Section “Summary of Work.”

B. Section “Substitutions Procedures.”

C. Section “Construction Progress Documentation.”

D. Section “Submittal Procedures.”

E. Section “Shop Drawings, Product Data and Samples.”

F. Section “Product Requirements.”

G. Section “Cutting and Patching.”

H. Section “Closeout Procedures.”

I. Section “Closeout Submittals.”

1.3 GENERAL:

A. Contractors, Subcontractors and suppliers representatives attending the meetings/conferences of this section shall be qualified and authorized to act on behalf of the entity each represents.

B. Contractor shall comply with the following meeting requirements during performance of the Contract.
   1. Arrangements: Arrange for a convenient, comfortable room in which to conduct the progress meetings, furnished as necessary to accommodate the people involved and to accomplish the purpose of the meeting. Owner will provide the room for the pre-construction meeting.
   2. Notices: Distribute written notices to all concerned at least seven (7) days in advance of the meeting date.

3. Records: Keep notes during each meeting and distribute them in the form of minutes of the meeting to all concerned within four (4) days after the adjournment of the meeting with three (3) copies furnished to the A/E and one (1) copy furnished to the Owner Representative.
4. Schedule Updating: Immediately following each progress meeting, where revisions to the Work Progress Schedule (WPS) have been made or recognized, revise the progress schedule. Reissue revised colored copies of the WPS concurrently with minutes of each meeting.

1.4 PRE-CONSTRUCTION CONFERENCE:

A. Chairman: The meeting will be presided over by the Owner Representative.

B. Attendance: The following persons will be expected to attend:
1. Owner's Representatives. Project Manager
2. A/E's Construction Administrator.
3. A/E's Consultants for Mechanical, Electrical and Structural Engineering.
4. A/E's special consultants as maybe required.
5. Contractor's General Superintendent and Project Manager.
6. Major Subcontractors including at least those for mechanical, plumbing and electrical work.

C. Agenda: Subjects shall include, but are not limited to the following:
1. Distribution of submittals. Refer to Sections "Submittal Procedures" and "Shop Drawings, Product Data, and Samples."
2. Sequence of critical work.
3. Relation and coordination by the Contractor.
4. Designation of responsible personnel.
5. Processing of Change Orders.
6. Distribution of Construction Documents.
7. Access to Work to permit inspection.
8. Maintaining project Record Documents.
9. Use of the premises, access to the Site, office and storage areas, and Owner's requirements.
10. Major equipment deliveries and priorities.
11. Safety and first aid procedure.
12. Security procedures.
13. Housekeeping procedures.
14. Additional subjects as requested by the Owner, the Architect/Engineer or the Contractor.
15. List of major Subcontractors and suppliers.

1.5 PROGRESS MEETINGS:

A. Chairman: Contractor's Project Manager or Project Superintendent shall preside over the meeting, prepare agenda, record minutes, and distribute copies within four (4) working days after meeting to participants, with three (3) copies furnished to the A/E and one (1) copy furnished to the Owner Presentative.

B. Attendance: The following persons will be expected to attend:
1. Owner's Representatives.
Project Manager
User Coordinator
Physical Plant representative
2. Architect/Engineer's Construction Administrator.

3. Architect/Engineer's Consultants for mechanical, electrical and structural engineering until excused from attendance.
4. A/E's special consultants as maybe required.
5. Contractor's General Superintendent, Project Superintendent and Project Manager.
6. Subcontractors who have work in progress.
7. Subcontractor who will start work within the next month.
8. Others as requested by the Owner's Representative, A/E, or Contractor.

C. Agenda: The Contractor will provide a written agenda including but not necessarily limited to the following items:
1. Present a brief written narrative of construction progress since the last monthly meeting containing:
   a. General description of work performed.
   b. Expectation of meeting scheduled dates.
   c. Description of current or anticipated delaying factors or problems, if any.
2. Review the updated WPS and present a written schedule analysis.
3. Review the Submittal Schedule/Log.
4. Review the COR Log.
5. Review of Requests for Information.
6. Review of project Record Documents.
7. Review/approval of the Progress Payment.
8. General discussion: Other outstanding/current business.

D. Review of Pre-Installation Meetings

E. At the end of the meeting, contractor is required to provide the Owner's Representative with:
1. One (1) set of Agenda (including all logs and information for meetings).
2. One (1) Disc of WPS
3. Two (2) colored copies of WPS
4. One (1) Cash Flow Schedule
5. One (1) Pay Estimate

F. Number of Meetings: A minimum of one progress meeting shall be held each month. Other weekly or biweekly progress meetings shall be held as determined by the Owner's Representative and shall cover those subjects as required by the Owner's Representative.

1.6 PRE-INSTALLATION MEETINGS:

A. Provide a list of all pre-installation meetings anticipated.

B. Convene a pre-installation meeting at the Project field office prior to commencing any work.

C. Require attendance of entities directly affecting, or affected by, work of Section.

D. Notify A/E and the Owner's Representative ten (10) days in advance of meeting date.

E. Contractor shall prepare agenda, preside at meeting, record minutes, and distribute copies within four (4) working days after meeting to participants as required by contract.

F. Review conditions of installation, preparation and installation procedures, and coordination with related work. Review submittals for all Work to be installed.

G. The Contractor shall maintain an adequate inspection system and perform such inspection to insure that the work called for by this contract conforms to the contract specifications and requirements.

H. The Contractor shall maintain complete inspection records and make them available to the Owner's Representative.

I. Subcontractor foreman or project manager are required to attend this meeting.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work.

1.2 SUBMITTALS

A. Submittals Schedule: Submit an electronic file in MS Office Project. Arrange the following information in a tabular format:
   1. Scheduled date for first submittal
   2. Specification Section number and title
   3. Submittal category (action or informational)
   4. Name of subcontractor
   5. Description of the Work covered
   6. Scheduled date for Architect's final release or approval

B. Contractor's Construction Schedule: Submit an electronic copy of the initial schedule, large enough to show entire schedule for entire construction period.

C. CPM Reports: Concurrent with CPM schedule, submit an electronic copy of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
   3. Total Float Report: List of all activities sorted in ascending order of total float.
   4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.

D. Daily Construction Reports: Submit an electronic copy at monthly intervals, when requested.

E. Field Condition Reports: Submit an electronic copy at time of discovery of differing conditions.

F. Special Reports: Submit an electronic copy at time of unusual event.

1.3 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

1.2 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
   1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
   2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

1.3 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
   2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
   4. Startup and Testing Time: Include not less than seven days for startup and testing.
   5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's and Williamson County Project Manager administrative procedures necessary for certification of Substantial Completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   4. Work Restrictions: Show the effect of the following items on the schedule:
      a. Seasonal variations
      b. Environmental control
   5. Work Stages: Indicate important stages of construction for each major portion of the

Work, including, but not limited to, the following:

a. Submittals
b. Mockups
c. Fabrication
d. Sample testing
e. Deliveries
f. Installation
g. Tests and inspections
h. Adjusting
i. Curing
j. Startup and placement into final use and operation

6. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Structural completion
   b. Permanent space enclosure
   c. Completion of mechanical installation
   d. Completion of electrical installation
   e. Substantial Completion

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
   1. Refer to Division 1 Section "Payment Procedures" for cost reporting and payment procedures.
   2. Contractor shall assign cost to construction activities on the CPM schedule. Costs shall not be assigned to submittal activities unless specified otherwise but may, with Architect's approval, be assigned to fabrication and delivery activities. Costs shall be under required principal subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
   3. Each activity cost shall reflect an accurate value subject to approval by Architect.
   4. Total cost assigned to activities shall equal the total Contract Sum.

F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Projects using CPM schedules should begin with a preliminary network diagram of type described below or a preliminary bar-chart schedule.

C. Preliminary Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

D. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
   1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 14 days after date established for the Notice to Proceed.
      a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
   2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
   3. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.

E. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
   1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
      a. Preparation and processing of submittals
      b. Mobilization and demobilization
      c. Purchase of materials
      d. Delivery
      e. Fabrication
      f. Installation
      g. Testing
   2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
   3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and re- produce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
   4. Format: Mark the critical path. Locate the critical path near center of net- work; locate paths with most float near the edges.
      a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

F. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
   1. Contractor or subcontractor and the Work or activity
   2. Description of activity
   3. Principal events of activity
   4. Immediate preceding and succeeding activities
   5. Early and late start dates
   6. Early and late finish dates
   7. Activity duration in workdays
   8. Total float or slack time
   9. Average size of workforce
   10. Dollar value of activity (coordinated with the Schedule of Values)

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
   1. Identification of activities that have changed
   2. Changes in early and late start dates
   3. Changes in early and late finish dates
   4. Changes in activity durations in workdays

5. Changes in the critical path
6. Changes in total float or slack time
7. Changes in the Contract Time

1.5 REPORTS

A. Daily Construction Reports: Maintain a daily construction report recording the following information concerning events at Project site:
   1. List of subcontractors at Project site
   2. Approximate count of personnel at Project site
   3. Material deliveries
   4. High and low temperatures and general weather conditions
   5. Accidents
   6. Meetings and significant decisions
   7. Unusual events (refer to special reports)
   8. Stoppages, delays, shortages, and losses
   9. Emergency procedures
   10. Orders and requests of authorities having jurisdiction
   11. Change Orders received and implemented
   12. Proposed Construction Change Directives
   13. Construction Change Directives received and implemented
   14. Services connected and disconnected
   15. Equipment or system tests and startups
   16. Substantial Completions authorized

B. Field Condition Reports: Have field reports available for review by owner.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

C. Distribution: Provide electronic copy to Architect in MS Office Project format.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUBMITTAL PROCEDURES

A. General: Electronic copies of the Contract Drawings will be provided by Architect/Engineer for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Initial Review: Allow 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect/Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 15 days for review of each resubmittal.
   4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect/Engineer and to Architect's consultants, allow 21 days for review of each submittal. Submittal will be returned to Architect/Engineer before being returned to Contractor.
   5. Schedule submissions at least 40 days before reviewed submittals will be needed, in accordance with the above review times noted above (the above allows for one resubmittal review and distribution) and approved submittal schedule.

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
   1. Coordinate each submittal with requirements of work of Contract Documents.
   2. Contractor’s responsibility for errors and omissions in submittals is not relieved by Architect’s review of submittals.
   3. Contractor’s responsibility for deviations in submittals from requirements of Contract Documents is not relieved by Architect’s review of submittals, unless Architect/Engineer gives written acceptance of specific deviations.
   4. Notify Architect, in writing at time of submission, of deviations in submittals from requirements of Contract Documents.

E. Identification: Place a permanent label or title block on each submittal for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.

2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information on label for processing and recording action taken:
    a. Project name
    b. Date
    c. Name and address of Architect/Engineer
    d. Name and address of Contractor
    e. Name and address of Subcontractor
    f. Name and address of Supplier
    g. Name of Manufacturer
    h. Submittal number
    i. Number and title of appropriate Specification Section
    j. Drawing number and detail references, as appropriate
    k. Location(s) where product is to be installed, as appropriate
    l. Other necessary identification

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect/Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect/Engineer will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Use form acceptable to the Owner and Architect. Provide locations on form for the following information:
    a. Project name
    b. Date
    c. Destination (To)
    d. Source (from)
    e. Names of Subcontractor, Manufacturer, and Supplier
    f. Category and type of submittal
    g. Submittal purpose and description
    h. Specification Section number and title
    i. Drawing number and detail references
    j. Transmittal number, numbered consecutively
    k. Submittal and transmittal distribution record
    l. Remarks
    m. Signature of Transmitter

2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect/Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. When revised for resubmission, identify changes made since previous submission.
2. Mark revised submittals with original number and sequential alphabetic suffix. Note date and content of previous submittal.

3. Note date and content of revision in label or title block and clearly indicate extent of revision.

J. Allow space on submittals for Contractor and Architect/Engineer review stamps.

K. Resubmit submittals until they are marked 'REVIEWED'.

L. Distribution: Furnish copies of final submittals to Manufacturers, Subcontractors, Suppliers, Fabricators, Installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
1. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

M. Use for Construction: Use only final submittals with mark indicating 'REVIEWED'.
1. Begin no work which requires submittals until return of submittals with Architect's stamp and initials or signature indicating review.

N. Submittals not requested will not be recognized or processed.

1.2 CONSTRUCTION PROGRESS SCHEDULES

A. Submit preliminary outline Schedules within 15 days after date of Owner-Contractor Agreement for coordination with Owner's requirements. After review, submit detailed schedules within 7 days modified to accommodate revisions recommended by Architect/Engineer and Owner.

B. Related Section 01 32 16 – Construction Progress Schedule: Submit revised Progress Schedules with each Application for Payment.

C. Distribute copies of reviewed schedules to Project site file, Subcontractors, Suppliers, and other concerned parties.

D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

E. Submit computer generated horizontal bar chart or other approved form with separate line for each section of Work, identifying first work day of each week.

F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

G. Indicate estimated percentage of completion for each item of Work at each submission.

H. Submit separate schedule of submittal dates for shop drawings, product data, and samples, including Owner furnished products and products identified under Allowances, and dates reviewed submittals will be required from Architect/Engineer. Indicate decision dates for selection of finishes.

I. Indicate delivery dates for Owner furnished products and products identified under Allowances.

J. Revisions to Schedules:
1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.

2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate Contractors.

1.3 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of Manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give Manufacturer, trade name, model or catalog designation, and reference standards.

1.4 SUBCONTRACTOR LIST

A. Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, and telephone number of entity perform subcontract or supplying products
2. Number and title of related Specification Sections(s) coverby Subcontractor
3. Drawing number and detail references, as appropriate, covered by subcontract

B. Submit three copies of Subcontractor list, unless otherwise indicated. Architect/Engineer will return two copies.
1. Mark up and retain one returned copy as a Project Record Document.

1.5 PRODUCT DATA

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

C. Submit electronic copies to Contractor and Architect/Engineer.

D. Mark each copy to identify applicable products, models, options, and other data. Supplement Manufacturers' standard data to provide information specific to this Project.

E. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

F. Distribute copies after review.

1.6 SHOP DRAWINGS

A. Provide shop drawing submittals for each engineering specialty at the same time.

B. Submittals shall be arranged in sequence by Specification section number. Provide submittals only for specification sections that list this requirement.

1. Provide tabs for each section, labeled to match the associated specification. The page after each tab section shall contain a list of any exceptions that the Contractor is proposing.
2. Each page of the submittal shall be a clear copy or scan, indicating items and options proposed for use in the project with a graphical arrow. Items included on a submittal page that are not proposed for use shall be deleted with strike-through or other acceptable method that clearly distinguishes the proposed from non-relevant information.

C. Subject to the requirements in Division 1, submittals shall be provided in PDF form.
1. All format and informational requirements for submittals in binders apply to PDF submittals.
2. Multiple files may be submitted; however, these must be organized into a consistent format.
3. PDF submittal shall include a table of contents with page numbers listed for the beginning of each section.
4. Additionally, the PDF shall be formatted to include tab or chapter shortcuts, labeled with the associated specification section. These shortcuts shall allow the reader to jump to a tab or chapter associated with beginning of each specification section with a single action.
5. At Architect/Engineer's request, the Contractor shall submit hard copy versions in accordance with requirements outlined above.

D. Provide closeout submittals for all products used. Refer to related specification section for additional requirements.

E. Provide maintenance and warranty information with contact information for parts and service of equipment.

F. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
1. Dimensions
2. Identification of products
3. Fabrication and installation drawings
4. Roughing-in and setting diagrams
5. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
6. Shopwork manufacturing instructions
7. Templates and patterns
8. Schedules
9. Design calculations
10. Compliance with specified standards
11. Notation of coordination requirements
12. Notation of dimensions established by field measurement
13. Relationship to adjoining construction clearly indicated
14. Seal and signature of professional engineer if specified
15. Wiring Diagrams: Differentiate between Manufacturer-installed and field- installed wiring

G. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 22 by 24 inches.

H. Number of Copies: Submit five opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Architect/Engineer will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing

I. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

J. All work must ultimately comply with the contract documents unless Architect/Engineer gives specific written acceptance of specific deviations.

K. Distribute copies after review.

1.7 SAMPLES

A. Samples: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Samples For Initial Selection as Specified in Product Sections:
   1. Submit to Architect/Engineer for aesthetic, color, or finish selection.
   2. Submit samples of finishes from full range of Manufacturers' standard colors, textures, and patterns for Architect/Engineer selection.

C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

D. Include identification on each sample, with full Project information.

E. Submit number of samples specified in individual specification sections; Architect/Engineer will retain two samples.
   1. Architect/Engineer will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
   2. Retain one sample on construction site for field comparison as needed.

F. Samples will not be used for testing purposes unless specifically stated in specification section.

G. Distribute samples after review.

1.8 DESIGN DATA

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.9 TEST REPORTS

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.10 CERTIFICATES

A. When specified in individual specification sections, submit certification by Manufacturer, installation/application Subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.11 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.12 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.

B. Submit report within 10 days of observation to Architect/Engineer for information.

C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 ERECTION DRAWINGS

A. Submit drawings for Architect/Engineer's benefit as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

1.14 PROJECT WARRANTY AND MAINTENANCE MANUAL:

A. Prior to final payment, the Contractor shall furnish two complete sets, in tabbed standard size ring binders, of equipment data, maintenance information, operations instructions, and warranties for equipment and systems provided under this contract. See Section 01700 for detailed requirements.

B. Provide warranties as specified. Warranties shall not limit length of time for remedy of damages Owner may have by legal statute. Contractor, Supplier, or Installer responsible for performance of warranty shall sign warranties.

C. Material Safety Data Sheets (MSDSs): Submit information directly to County project manager.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

PART 4 - ARCHITECT'S ACTION

4.1 General: Architect/Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

A. Action Submittals: Architect/Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect/Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

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

C. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

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

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence and secure Manufacturers certification as certified installer, when applicable.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

D. 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. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

E. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

F. Perform Work by persons qualified to produce required and specified quality. The Contractor shall comply with applicable local, state, and federal codes and regulations.
   1. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for or this Project, whose work has resulted in construction with a record of successful in- service performance.
   2. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
   3. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
   4. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
   5. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
   6. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   7. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

8. Factory-Authorized Service Representative Qualifications: An authorized representative of Manufacturer who is trained and approved by Manufacturer to inspect installation of Manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

G. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

H. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

I. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work
   2. Incidental labor and facilities necessary to facilitate tests and inspections
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples
   4. Facilities for storage and field curing of test samples
   5. Delivery of samples to testing agencies
   6. Preliminary design mix proposed for use for material mixes that require control by testing agency
   7. Security and protection for samples and for testing and inspecting equipment at Project site

J. Coordination: Coordinate sequence of activities to accommodate required quality- assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.2 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.3 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving bids, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.4 LABELING

A. Attach label from agency approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label.
   1. Model number.
   2. Serial number.
   3. Performance characteristics.

1.5 MOCK-UP REQUIREMENTS

A. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect 14 days in advance of dates and times when mockups will be constructed.
   3. Demonstrate the proposed range of aesthetic effects and workmanship.
   4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
   5. Allow seven days for initial review and each re-review of each mockup.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect/Engineer.

1.6 TESTING AND INSPECTION SERVICES

A. Refer to Specifications Section 01 40 10 – Testing Laboratory Services.

B. Employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing.
   1. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time specialist and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

C. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Architect/Engineer and / or Owner.
   1. Laboratory: Authorized to operate at Project location.
   2. Laboratory Staff: Maintain full time registered Engineer on staff to review services.

3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

D. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Architect/Engineer or Owner.

E. The work will be observed by the Architect/Engineer (Owner's Representative) or the Owners field observer and performed to his satisfaction in accordance with the Contract Plans and Specifications. The Owner's representative and Architect/Engineer will decide all questions which may arise as to the quality of acceptability of materials furnished and work performed; the manner of performance and rate of progress of the work; the interpretations of the contract plans and specifications; and the acceptable fulfillment of the contract on the part of the Contractor. The Owner's decisions will be final, and he will have executive authority to enforce and make effective such decisions and orders if the contractor fails to carry out the work promptly.

F. Reports will be submitted by independent firm to Architect/Engineer, County Project Manager (2 copies) and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

G. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services.
2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

H. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

I. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect/Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

J. Agency Responsibilities:
1. Test samples of mixes submitted by Contractor.
2. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
3. Perform specified sampling and testing of products in accordance with specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-conformance of Work or products.
6. Perform additional tests required by Architect/Engineer.
7. Attend preconstruction meetings and progress meetings.

K. Agency Reports: After each test, promptly submit two copies of report to Architect/Engineer and to Contractor. When requested by Architect/Engineer, provide interpretation of test results.

L. Limits On Testing Authority:

1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

M. Any materials and/or workmanship which are rejected by the Engineer by reason of failure to conform to the requirements of the plans or specifications shall be removed and replaced at Contractor's expense, including testing expense to correct faulty work.

N. Inspections and testing required by law, ordinances, rules and regulations or other public authorities are the responsibility of the Contractor. It is the sole responsibility of the Contractor to call for testing and any work not tested will be automatically rejected.

O. Contained in the various specification sections are requirements for certification of products, testing, adjusting, and balancing of equipment and other tests and standards. Testing is required for, but not limited to, the following items of work:
1. Soils-compaction control and hydrocarbon concentrations
2. Cast-in-place concrete
3. Concrete reinforcement
4. Asphalt pavement
5. Cement-Sand Backfill material
6. Crushed limestone base materials
7. Water and sludge
8. Other items in the Scope of Work

1.7 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel; provide access to the work area.

B. Provide to laboratory, preliminary representative samples of materials to be tested in required quantities.

C. Furnish labor and equipment:
1. To provide access to the work to be tested.
2. To obtain and handle samples at the site.
3. To facilitate inspections and tests.
4. For laboratory's exclusive use for storage and curing of test samples.

1.8 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Architect/Engineer 30 days in advance of required observations. Observer subject to approval of Architect/Engineer or Owner. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Refer to Section 01 33 00 - Submittal Procedures, MANUFACTURERS' FIELD REPORTS article.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted
   2. Description of the Work tested or inspected
   3. Date test or inspection results were transmitted to Architect
   4. Identification of testing agency or special inspector conducting test or inspection

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.4 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
   2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.2 TEMPORARY ELECTRICITY

A. Provide and pay for power service required from utility source as needed for construction operation.
   1. Exercise measures to conserve energy.
   2. Provide and install temporary overhead power from Utility Company.
   3. Set temporary meter and switchgear at start of construction.
   4. Specified switchgear shall not be used to construct building until building is in “dry- in" stage.

B. Provide power outlets, with branch wiring and distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.

C. Permanent convenience receptacles may be utilized during construction.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain lighting for construction operations. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

B. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.

D. Maintain lighting and provide routine repairs.

E. Permanent building lighting may be utilized during construction.

1.4 TEMPORARY HEATING

A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

B. Prior to operation of permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Owner must authorize use of permanent system for temporary purposes.

C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in product sections.

1.5 TEMPORARY COOLING

A. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations.

B. Enclose building prior to activating temporary cooling in accordance with Enclosures article in this section.

C. Prior to operation of permanent equipment for temporary cooling purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Owner must authorize use of permanent system for temporary purposes.

D. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.6 TEMPORARY VENTILATION

A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases. Owner must authorize use of permanent system for temporary purposes.

1.7 TELEPHONE SERVICE

A. Provide, maintain, and pay for telephone service to field office at time of project mobilization.

B. Contractor shall provide, maintain, and pay for telephone service for field operations at time of project mobilization.

C. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.

1.8 FACSIMILE SERVICE

A. Provide, maintain and pay for facsimile service and dedicated telephone line to field office at time of project mobilization.

1.9 TEMPORARY WATER SERVICE

A. Provide and pay for suitable quality water service as needed to maintain specified conditions for construction operations. Exercise measure to conserve energy.

B. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

1.10 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.

B. Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1.11 FIELD OFFICES AND SHEDS

A. Office: Weather tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture drawing rack and drawing display table.

B. Provide space for Project meetings, with table and chairs to accommodate 10 persons.

C. Locate offices and sheds minimum distance of 30 feet from existing and new structures. Location shall be within the project site's limit of construction and approved by the Owner. No use of Owner equipment will be permitted.

D. When permanent facilities are enclosed with operable utilities, relocate offices and storage into building, with written agreement of Owner, and remove temporary buildings.

E. Construction: Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations with steps and landings at entrance doors.
   1. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of Work; remove when no longer needed at completion of Work.
   2. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.
   3. Exterior Materials: Weather resistant, finished color acceptable to Owner.
   4. Interior Materials in Offices: Sheet type materials for walls and ceilings, pre- finished or painted; resilient floors and bases.
   5. Lighting for Offices: 50 ft C at desk top height, exterior lighting at entrance doors.
   6. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

F. Environmental Control:
   1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions.
   2. Storage Spaces: Heating and ventilation as needed to maintain products in accordance with Contract Documents; lighting for maintenance and inspection of products.

G. Storage Areas And Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01 60 00 - Product Requirements.

H. Preparation: Fill and grade sites for temporary structures sloped for drainage away from buildings.

I. Installation:
   1. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.
   2. Employee Residential Occupancy: Not allowed on Owner's property.

J. Maintenance And Cleaning:

K. Maintain approach walks free of mud, water, and snow.

L. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

1.12 VEHICULAR ACCESS

A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.

B. Construct temporary culverts to span low areas and allow unimpeded drainage.

C. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.

D. Location approved by Owner.

E. Provide unimpeded access for emergency vehicles. Maintain 20 feet wide driveways with turning space between and around combustible materials.

F. Provide and maintain access to fire hydrants and control valves free of obstructions.

G. Provide means of removing mud from vehicle wheels before entering streets.

H. Do not use existing on-site roads for construction traffic.

1.13 PARKING

A. Provide temporary surface parking areas to accommodate construction personnel.

B. Locate as approved by Owner.

C. When site space is not adequate, provide additional off-site parking.

D. Use of existing on-site streets and driveways used for construction traffic is not permitted.

E. Do not allow heavy vehicles or construction equipment in parking areas.

F. Do not allow vehicle parking on existing pavement.

G. Permanent Pavements and Parking Facilities:
   1. Prior to Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.

2. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

H. Maintenance:
1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

I. Removal, Repair:
1. Remove temporary materials and construction when permanent paving is usable.
2. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
3. Repair permanent facilities damaged by use, to original or specified condition.

J. Mud From Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.14 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from the construction operations. Comply with requirement s of authorities having jurisdiction. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site immediately after filled. Remove waste upon owner’s request.

1.15 PROJECT IDENTIFICATION

A. Project Identification Sign:
1. One painted sign, 32 sq ft area, bottom 6 feet above ground.
2. Content:
   a. Project number, title, logo and name of Owner as indicated on Contract Documents.
   b. Name of Prime Contractor.
3. Graphic Design, Colors, Style of Lettering: Reviewed and approved by Owner.
4. No other signs are allowed without Owner permission except those required by law.

B. Design sign and structure to withstand wind velocity per building code.

C. Sign Painter: Experienced as professional sign painter.

D. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

E. Show content, layout, lettering and color.

F. Sign Materials:
   1. Structure and Framing: New wood, structurally adequate.
   2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inches thick standard large sizes to minimize joints.
   3. Rough Hardware: Galvanized
   4. Paint and Primers: Exterior quality.

G. Installation:
   1. Erect at designated location.
   2. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
   3. Install sign surface plumb and level, with butt joints. Anchor securely.
   4. Paint exposed surfaces of sign, supports, and framing.

H. Maintenance: Maintain signs and supports clean, repair deterioration and damage.

I. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore area.

1.16 TRAFFIC REGULATION

A. Signs, Signals, And Devices:
   1. Post Mounted and Wall Mounted Traffic Control and Informational Signs: As approved by
   2. authority having jurisdiction.
   3. Traffic Cones and Drums, Flares and Lights: As approved by authority having jurisdiction.
   4. Flag person Equipment: As required by authority having jurisdiction.

B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

C. Flares And Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

D. Haul Routes:
   1. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
   2. Confine construction traffic to designated haul routes.

E. Traffic Signs and Signals:
   1. Provide signs at approaches to site and on site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
   2. Relocate as Work progresses, to maintain effective traffic control.

F. Removal:
   1. Remove equipment and devices when no longer required.
   2. Repair damage caused by installation.
   3. Remove post settings.

1.17 FIRE PREVENTION

A. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
   1. Prohibit smoking with buildings under construction. Designate area on site where smoking is permitted. Provide approved ashtrays in designated smoking areas.
   2. Establish fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.

B. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
   1. Provide minimum one fire extinguisher in every construction trailer and storage shed.

1.18 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.19 ENCLOSURES AND FENCING

A. Construction: Commercial grade chain link fence.

B. Provide 6 feet high fence around construction site; equip with vehicular and pedestrian gates with locks. Contractor may tie into existing chain link fence if it exists to complete enclosure of the construction site.

C. Exterior Enclosures:
   1. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.20 SECURITY

A. Security Program:
   1. Protect Work and Owner's operations from theft, vandalism, and unauthorized entry.
   2. Initiate program in coordination with Owner's existing security system at project mobilization.
   3. Maintain program throughout construction period until Owner occupancy.

B. Entry Control:
   1. Restrict entrance of persons and vehicles into Project site.
   2. Allow entrance only to authorized persons with proper identification.
   3. Maintain log of workers and visitors, make available to Owner on request.

C. Personnel Identification (Owner occupied sites):

1. Provide identification badge to each person authorized to enter premises.
2. Badge To Include: Personal photograph, name and assigned number, expiration date and employer.
3. Maintain list of accredited persons, submit copy to Owner on request.
4. Require return of badges at expiration of their employment on the Work.

D. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

E. Restrictions:
1. Do no work on days indicated in Owner-Contractor Agreement.

1.21 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.22 DUST CONTROL

A. Execute Work by methods to minimize raising dust from construction operations.

B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.23 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.

B. Minimize surface area of bare soil exposed at one time.

C. Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow.

D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.

E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.24 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.25 PEST CONTROL

A. Provide methods, means, and facilities to prevent pests and insects from damaging the Work.

1.26 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Comply with pollution and environmental control requirements of [authorities having jurisdiction.

1.27 RODENT CONTROL

A. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.28 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.

B. Remove underground installations. Grade site as indicated on Drawings.

C. Clean and repair damage caused by installation or use of temporary work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor.
   2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 1 Section "Closeout Requirements."

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.3 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use form provided by Owner, reference Section 01 25 00 Substitution Procedures.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified material or product cannot be provided.
      b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as

performance, weight, size, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
   a. Form of Acceptance: Change Order.
   b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

B. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
      a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
      b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 “Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage
   1. Store products to allow for inspection and measurement of quantity or counting of units.
   2. Store materials in a manner that will not endanger Project structure.
   3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   4. Store cementitious products and materials on elevated platforms.
   5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   7. Protect stored products from damage and liquids from freezing.
   8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
   1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Refer to Division 2 – 14, 21, 22-28, 31-33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 70 00 – Execution and Closeout Requirements.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make selection.
   5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
   6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
   7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:
   1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   3. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
   4. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
   5. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
   6. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
   7. Visual Matching Specifications: Where Specifications include the phrase “as selected from manufacturer’s colors, patterns, textures” or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
      a. Standard Range: Where specifications include the phrase “standard range of colors, patterns, textures” or similar phrase, Architect will select color pattern, or texture from manufacturer’s product line that does not include premium items.
      b. Full Range: Where Specifications include the phrase “full range of colors, patterns, textures” or similar phrase, Architect will select color, pattern or texture form manufacturer’s product line that include both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Reference Section 01 25 00 – Substitutions Procedures.

2.3 COMPARABLE PRODUCTS

A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements.
   1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   3. Evidence that proposed product provides specified warranty.
   4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
   4. Maintain minimum headroom clearance of 80-ft. in spaces without a suspended ceiling.

B. Comply with Manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

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

E. Tools and Equipment: Do not use equipment or tools that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

1.2 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
   1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
   2. Pre-installation Conferences: Include Owner's construction forces at pre- installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

1.3 PROTECTING INSTALLED CONSTRUCTION

A. Provide for temperature and relative humidity as per manufacturer’s written instructions.

B. Protect installed Work and provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Prohibit traffic from landscaped areas.

1.4 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of Manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use

cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

1.5 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer and Owner 14 days prior to start-up of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable manufacturer's representative and Contractors' personnel in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report in accordance with Section 01 33 00 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.6 TESTING, ADJUSTING AND BALANCING

A. Refer to Mechanical and Electrical Specifications for specific requirements.

B. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.7 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of substantial completion.

B. Demonstrate Project equipment and instructed by qualified representative who is knowledgeable about the Project.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time at equipment location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

G. Required instruction time for each item of equipment and system is specified in individual sections.

1.8 FINAL CLEANING

A. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer’s written instruction.

C. Conduct the following cleaning operations before requesting inspection for certification of Final Completion for entire or a portion of the Project:
   1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   4. Remove tools, construction equipment, machinery, and surplus material from Project site.
   5. Remove snow and ice to provide safe access to building.
   6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   8. Sweep concrete floors broom clean in unoccupied spaces.
   9. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
   10. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace

chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

11. Remove labels that are not permanent.
12. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
13. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
14. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
15. Replace parts subject to unusual operating conditions.
16. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
17. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
18. Clean ducts, blowers, and coils if units were operated without filters during construction.
    a. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
    b. Leave Project clean and ready for occupancy.

D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

1.9 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.
   7. Manufacturer’s certificates
   8. Reviewed Submittals

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Label and file Record Documents in accordance with Section number listings in Table of Contents of this Project Specifications Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

E. Record information concurrent with construction progress, not less than weekly.

F. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.

2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

G. Record Drawings and Shop Drawings: Provide felt tip pens, maintaining separate colors for each major system, for recording information. Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.
   6. Changes made by Addenda and modifications.
   7. References to related shop drawings and modifications.

H. Submit two copies of documents to Architect/Engineer prior to or on Substantial Completion inspection.
   1. Transmit with cover letter listing:
      a. Date
      b. Project title and number
      c. Contractor's name, address, and telephone number.
      d. Number and title of each Record Document.
      e. Signature of Contractor or authorized representative.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 x 11-inch (A4) text pages, three D side ring binders with durable covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
         1) For equipment having a make, model and serial number, it shall be recorded in the O&M manuals.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.

f. Maintenance instructions for [special] finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:
   a. Shop drawings and product data.
   b. Air and water balance reports.
   c. Certificates.
   d. Originals of warranties and bonds.

F. Submit two copies of documents to Architect/Engineer prior to or on Substantial Completion inspection.
   1. Transmit with cover letter listing:
      a. Date
      b. Project title and number
      c. Contractor's name, address, and telephone number.
      d. Number and title of each Record Document.
      e. Signature of Contractor or authorized representative.

1.11 MANUAL FOR MATERIALS AND FINISHES

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 15 days prior to substantial completion. Draft copy will be reviewed and returned with Architect/Engineer comments. Revise content of document sets as required prior to substantial completion.

D. Submit two sets of revised final volumes in final form before or on date of substantial completion

E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. [Include information for re-ordering custom manufactured products.

F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.

H. Additional Requirements: As specified in individual product specification sections.

I. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.12 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit a preliminary digital draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review and return a digital copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit a digital copy of completed volumes 15 days prior to substantial completion Draft copy will be reviewed and returned with Architect/Engineer comments. Revise content of document sets as required prior to substantial completion.

D. Submit one (1) digital and one (1) hardcopy set of revised final volumes in final form prior to or on date of substantial completion inspection.

E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

F. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

G. Include color coded wiring diagrams as installed.

H. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.

I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

J. Include servicing and lubrication schedule, and list of lubricants required.

K. Include manufacturer's printed operation and maintenance instructions.

L. Include sequence of operation by controls manufacturer.

M. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

N. Include control diagrams by controls manufacturer as installed.

O. Include Contractor's coordination drawings, with color coded piping diagrams as installed.

P. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

Q. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

R. Include test and balancing reports as specified in Section 01 40 00 - Quality Requirements.

S. Additional Requirements: As specified in individual product specification sections.

T. Include listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.13 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.

B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to or on substantial completion inspection.

1.14 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by- 11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark 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 Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

F. Submit prior to or on substantial completion inspection.

G. For equipment or components parts of equipment put into service during construction or for items of Work for which acceptance is delayed beyond Date of Substantial Completion refer to the Building General Conditions.

1.15 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by

Owner. Label with manufacturer's name and model number where applicable.

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
15. Complete work on items listed on Punch Lists.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.16 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A or form acceptable to the Owner and Architect..

1. Organize list of spaces in sequential order, starting with exterior areas first.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

1.17 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
2. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will

notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.18 COMPLETED FINAL PUNCHLIST INSPECTION

A. Correct or complete all items on the punchlist before requesting final payment. Unless otherwise agreed upon, the contractor has seven (7) days of receipt of final punchlist. When the final punchlist is complete and the Contract is fully satisfied according to Contract Documents, a certificate establishing the date of Final Completion will be issued.

B. Refer to the Building General Conditions for Owner's right to complete the work in the event the contractor does not complete the final punchlist.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 73 10

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes procedural requirements for cutting and patching.

B. Definition: Cutting and patching includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and repair required to restore surfaces to their original condition.

C. Refer to other sections for other requirements and limitations applicable to cutting and patching individual parts of the Work.

D. Coordinate cutting and patching with demolition requirements specified in Specification Section "Selective Demolition".

1.2 SUBMITTALS

A. Cutting and Patching Plan: Submit a proposal to the Owner's representative, describing procedures at least 14 calendar days in advance of the time cutting and patching will initially be performed.

B. Include the following information, as applicable:
   1. Description of the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.
   2. Description of the anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in appearance and other significant visual elements.
   3. List of products to be used and entities that will perform work.
   4. Dates and hours of operation when cutting and patching will be performed.
   5. Compatibility and cohesion characteristics of patching compounds with adjacent materials.
   6. Details and engineering calculations showing integration of reinforcement with the original structure, where cutting and patching involves adding reinforcement to structural elements.

C. Approval by the Owner to proceed with cutting and patching does not waive the right to later require complete removal and replacement of unsatisfactory work.

D. Samples: Provide cutting and patching samples for the following items within 14 calendar days after notice to proceed in order that special reviews and coordination can be arranged with approval authorities:

1.3 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.

B. The cutting and patching plan shall include but not be necessarily limited to work required at the following structural elements:
   1. Foundation construction.
   2. Bearing and retaining walls.
   3. Structural concrete.
   4. Structural steel.
   5. Lintels.
   6. Timber and primary wood framing.
   7. Structural decking.
   8. Stair systems.
   9. Miscellaneous structural metals.
   10. Exterior curtain-wall construction.
   11. Equipment supports.
   12. Piping, ductwork, vessels, and equipment.
   13. Structural systems of other construction.
   14. Operational Limitations: Do not cut and patch operating elements, safety related systems, or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements, safety related systems or related components in a manner that would result in increased maintenance or decreased operational life or safety.

C. The cutting and patching plan shall include but not be necessarily limited to work required at the following operating elements or safety related systems:
   1. Primary operational systems and equipment.
   2. Air or smoke barriers.
   3. Water, moisture, or vapor barriers.
   4. Membranes and flashings.
   5. Fire protection systems.
   6. Noise and vibration control elements and systems.
   7. Control systems.
   8. Communication systems.
   9. Conveying systems.
   10. Electrical wiring systems.
   11. Operating systems of other construction.
   12. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Owner's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction that is cut and patched in a visually unsatisfactorily manner.

D. Retain the original installer or fabricator to cut and patch exposed work if the original installer or fabricator is identified in the Contract Documents or is known to the Contractor and is available for the work.

E. If it is not possible to engage the original installer or fabricator, engage a Specialist who is specifically experienced in the work.

F. The cutting and patching plan shall include but not be necessarily limited to work required at the following visual elements:
   1. Processed concrete finishes.
   2. Stonework and stone masonry.
   3. Ornamental metal.
   4. Matched-veneer woodwork.
   5. Preformed metal panels.
   6. Firestopping.
   7. Window wall system.

8. Stucco and ornamental plaster.
9. Acoustical ceilings.
10. Terrazzo.
11. Finished wood flooring.
12. Fluid-applied flooring.
13. Carpeting.
14. Aggregate wall coating.
15. Wall covering.
16. Swimming pool finishes.
17. Mechanical system enclosures, cabinets, or covers.

1.4 EXISTING WARRANTIES

A. Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to avoid any existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials identical to existing materials to the maximum extent available.

B. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

C. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

B. Before proceeding with cutting and patching involving two or more trades, meet at the Project site with the entities providing or affected by the cutting and patching. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

A. Provide temporary support of work to be cut.

B. Protect existing conditions during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Bypass in-service existing pipe, conduit, or ductwork scheduled to be removed or relocated before cutting.

3.3 PERFORMANCE

A. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

B. Cutting: Cut existing construction using methods least likely to damage elements retained and adjoining construction. Where possible, review proposed procedures with the original installer and comply with the original installer's recommendations.

C. In general, use hand or small power tools designed for sawing or grinding, not for hammering and chopping.

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

E. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

F. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.

G. Comply with requirements of applicable Division 2 sections where cutting and patching requires excavating and backfilling.

H. After utility services are bypassed, cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

I. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

J. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

K. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will eliminate evidence of patching and refinishing.

L. Where removed walls or partitions extends one finished area into another finished area, patch and repair floor and wall surfaces to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

M. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface that contains the patch after the area has received primer and other undercoats.

N. Patch, repair or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

O. Perform cutting and patching work listed in Section "Work Restrictions" during Owner’s Unoccupied Hours.

3.4 CLEANING

A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items.

B. Thoroughly clean piping, conduit, and similar features before applying paint, restored pipe coverings, or other finishing materials.

END OF SECTION

SECTION 01 73 20

SELECTIVE DEMOLITION

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. Section Includes:
   1. Demolition and removal of selected portions of building or structure.
   2. Salvage of existing items to be reused or recycled.

B. Related Requirements:
   1. Section "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
   2. Section "Execution Requirements" for cutting and patching procedures.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection , for dust control . Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Predemolition Photographs or Video: Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 QUALITY ASSURANCE

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

1.9 FIELD CONDITIONS

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

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to **MEP Engineer**.

E. Survey of Existing Conditions: Record existing conditions by use of measured drawings preconstruction photographs preconstruction videotapes and templates.
   1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
   1. Comply with requirements for existing services/systems interruptions specified in Section "Summary."
   2. Owner will arrange to shut off indicated services/systems when requested by Contractor.
   3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
      a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
      b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
      c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
      d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
      e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
      f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
      g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Comply with requirements for access and protection specified in Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly. Comply with requirements in Section "Construction Waste Management."

B. Removed and Salvaged Items:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area off-site designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Comply with requirements specified in Section "Construction Waste Management."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 01 73 50

FIRE PREVENTION CAUTIONS FOR HOT WORK

PART 1 - GENERAL

1.1 SUMMARY

A. This section applies to safeguards to be observed in performing hot work, including welding, soldering, brazing and other operations where open flames or implements utilizing heat are used.

1.2 SAFETY PRECAUTIONS

A. The Contractor shall ensure that operations involving the use of open-flame, electrical arc equipment or flammable substances are not conducted until a permit for welding, cutting, and burning has been completed, signed and issued by the Building Manager.

B. The Building Manager must approve the location of asphalt kettles for roofing work.

C. Prior to commencing operations, a positive determination shall be made that it is impractical to conduct the hot work in a shop area or outside of the building. Coordinate suitable locations for hot equipment operations agreeable to the Contracting Officers Representative.

1.3 NOTIFICATION

A. The Contractor shall notify the Contracting Officers Representative of the area of operations for each day and of all subsequent changes that occur.

B. The Contractor shall notify the Building Manager of all locations where hot work has been performed not less than 30 minutes or more than 90 minutes after work is completed or stopped for the day.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSPECTION

A. Before starting operations, the Contractor shall furnish trained personnel to provide fire watches for locations where hot work is to be performed. One fire watcher may observe several locations in a relatively small contiguous area if approved by the Contracting Officers Representative. Contractor shall furnish suitable type, fully-charged, operable portable fire extinguisher to each fire watcher.
   1. The Contractor shall provide fire watchers who know how to operate the fire extinguisher, how to turn on a fire alarm and how to summon the fire department.

B. Before starting operations, take suitable precautions to minimize the hazard of a fire communicating to the opposite side of walls, floors, ceilings and roofs from the operations.

3.2 SAFETY MEASURES

A. Hot work shall not be done in or near rooms or areas where flammable liquids or explosive vapors are present or thought to be present. A combustible gas indicator (explosimeter) test shall be conducted to assure that each area is safe. The Contractor is responsible for arranging and paying for each test.

B. Insofar as possible, the Contractor shall remove and keep the area free from all combustibles, including rubbish, paper and waste within a radius of 25 feet (7.62 m) from hot operations.
   1. If combustible material cannot be removed, the Contractor shall furnish fireproof blankets to cover such materials. At the direction of the Building Manager or Contracting Officer's Representative, floors, walls, and ceilings of combustible material shall be wetted thoroughly with water before, during, and after operations sufficiently to afford adequate protection.
   2. Where possible, the Contractor shall furnish and use baffles of metal or gypsum board to prevent the spraying of sparks, hot slag and other hot particles into surrounding combustible material.

C. The Contractor shall prevent the spread of sparks and particles of hot metal through open windows, doors, and holes and cracks in floors, walls, ceilings and roofs. Cylinders of gas used in hot work shall be placed a safe distance from the work. The Contractor shall provide hoses and equipment free of deterioration, malfunction and leaks. Suitable supports shall be provided to prevent accidental overturning of cylinders. All cylinder control valves shall be shut off while in use with the gas pressure regulator set at 15 psi (103 kPa) or less.

D. When hot work operations are completed or ended for the day, each location of the days work shall be inspected by the Contractor 30 to 60 minutes after completion of operations to detect for hidden or smoldering fires and to ensure that proper housekeeping is maintained. Contractor shall cleanup the area of work at the end of each shift or workday.

E. Where sprinkler protection exists, the sprinkler system shall be maintained without interruption while operations are being performed. If operations are performed close to automatic sprinkler heads, gypsum board sheets or damp cloth guards may be used to shield the individual heads temporarily. The heads shall be inspected by the Contractor immediately after hot work operations cease, to ensure all materials have been removed from the heads and that the heads have not been damaged.

F. Suitable type, fully-charged, operable portable fire extinguisher shall be available at all times during hot work operations.

G. If any of the above safeguards are not employed, or are violated, the Contracting Officers Representative may, by written notice, stop the work until compliance is obtained. Such stoppage shall not relieve the Contractor form performing his work within the Contract period for the Contract price.

END OF SECTION

SECTION 01 74 00

WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 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 manufacturer’s 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. Section "Submittal Procedures" specifies procedures for submitting warranties.
   2. Section “Closeout Procedures" specifies contract closeout procedures.
   3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.
   4. 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 Engineer prior to the date certified for Substantial Completion. If the 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 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 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 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 8-1/2-by-11-inch (115-by-280-mm) paper.
   1. Provide heavy paper dividers with celluloid covered tabs 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 WARRANTY

A. All components, parts, assemblies shall be guaranteed against defects and workmanship for a period of one (1) year after acceptance, unless otherwise specified herein. Expressed warranties are conditionally based on the acceptance and on the requirements that the items covered within the guarantee are used and maintained according to the manufacturer's recommendation. Replacement of defective or malfunctioning units shall include all necessary parts and labor.

B. Warranty commences at time of acceptance, as provided in writing, as described in Closeout Procedures, and continues for the previously indicated duration.

C. The following procedures shall govern the warranty period. Within 30 days after the Owner accepts the system, the Contractor shall initiate the warranty period by formally transmitting to the Owner commencement notification of the period for the systems, subsystems, and devices previously accepted. Warranty notification will be formally transmitted in a like manner for subsequent phases or portions thereof which remain incomplete at the time initial notification.

D. Remote Response: During the warranty period, the Contractor shall provide immediate telephone assistance to Owner upon request and shall address items that can be resolved via telephone line communication within four hours of Owner's initial request.

E. On-Site Response: During warranty period, any failed system components shall be replaced/repaired within 24 hours of Owner's request. Technicians responding to on-site requests shall be prepared with replacement parts so that the system is functional when they leave.

END OF SECTION

SECTION 01 74 10

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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 administrative and procedural requirements for the following:
   1. Disposing of nonhazardous demolition and construction waste.

B. Related Sections include the following:
   1. Specification Section "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements**,** and for disposition of hazardous waste.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 SUBMITTALS

A. Waste Management Plan: Submit three (3) copies of plan within fourteen (14) days of date established for the Notice to Proceed.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include separate reports for demolition and construction waste. Include the following information:
   1. Material category.

2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit three (3) copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: LEED Accredited Professional by U.S. Green Building Council.

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

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. **Include separate sections in plan for demolition and construction waste.** Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total

quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Architect, Owner and Construction Manager. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

3.2 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials and dispose of at designated spoil areas on Owner's property.

D. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Operating and maintenance manuals

B. Maintenance instruction.

C. Maintenance materials.

D. Warranties.

E. Project record documents.

1.2 RELATED SECTIONS

A. Section “Submittal Procedures.”

B. Section “Shop Drawings, Product Data and Samples”: Submittal schedule warranty requirements.

C. Section “Closeout Procedures.”

D. Individual Specification Sections: Special Project Warranties

1.3 OPERATING AND MAINTENANCE MANUALS

A. FORMAT:
1. Prepare prior to final inspections four (4) sets of operating and maintenance data, each containing data bound in commercial quality 3-ring binders with plastic covers. Minimum binder size 2". Also, provide two (2) digital copies on cd-rom of all operating and maintenance manuals in Adobe Acrobat format which are indexed and searchable.
2. Cover: Identify each volume, front cover and spine, with type or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS", name of Project, Project No., location, Contractor, date of Substantial Completion and Volume Number.
3. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Specification. Include Tab for each section number, systems and equipment number.
4. The work covered by these manuals will not be accepted nor will the Final Inspection and Acceptance be conducted until the Owner’s Representative has received the manuals. The A/E will check for compliance with the specifications and furnish the approved copies to the Owner’s Representative, who will make distribution. ***Payment will be withheld unless O&M Manuals submitted are in accordance with this specification.***

B. CONTENTS, EACH VOLUME:
1. Arrange typewritten table of contents for each volume, in systematic order:
2. A list of each product required to be included with name, address and telephone number of:

a. Subcontractor or installer.
b. Maintenance contractor, as appropriate.
c. Local source of supply for parts and replacement.

3. Identifying each product by product name and other identifying symbols.
4. Product Data:
   a. Include only those sheets which are pertinent to specific product with product clearly identified.
   b. Delete references to inapplicable information.
5. Drawings:
   a. Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems and control and flow diagrams.
   b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
6. Written Text: As required to supplement product data for particular installation to provide logical sequence of instructions for each procedure.
7. Miscellaneous Data:
   a. Furnish copy of each warranty, bond and service contract issued.
   b. Furnish proper procedures in event of failure and instances which might affect validity of warranties or bonds.

C. MANUAL FOR MATERIALS AND FINISHES:
1. Architectural Products, Applied Materials, and Finishes:
   a. Provide manufacturer's data giving full information on product:
      (1). Catalog number, size and composition.
      (2). Color and texture designations.
      (3). Information required for re-ordering special manufactured products.
   b. Provide instructions for care and maintenance including:
      (1). Manufacturer's recommendation for types of cleaning agents and methods.
      (2). Cautions against cleaning agents and methods which are detrimental to product.
      (3). Recommended schedule for cleaning and maintenance.
   c. Provide a summary listing of all exterior and interior colors.
2. Additional Requirements: Refer to respective Specification Sections.

D. MANUAL FOR EQUIPMENT AND SYSTEMS:
1. Each Type of Equipment and System:
   a. Provide description of unit and component parts including:
      (1). Function, normal operating characteristics and limiting conditions.
      (2). Performance curves, engineering data and tests.
      (3). Complete nomenclature and catalog number of replaceable parts.
      (4). Dimensional drawing.
   b. Operating Procedures: Include the following.
      (1). Start-up, break-in, routine and normal operating instructions.
      (2). Regulation, control, stopping, shut-down and emergency instructions.
      (3). Summer and winter operating instructions.
      (4). Special operating instructions.
   c. Maintenance Procedures: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing and checking instructions.
   d. Provide servicing and lubrication schedule including list of lubricants required.
   e. Include manufacturer's printed operating and maintenance instructions.
   f. Describe sequence of operation by control manufacturer.
   g. Include original manufacturer's parts list, price lists, illustrations, assembly drawings and diagrams required for maintenance, predicted life of parts subject

to wear and items recommended to be stocked as spare parts.
h. Include control diagrams by controls manufacturer.
i. Coordinate drawings and color coded piping diagrams.
j. Schedule valve tag numbers with location and function of each valve.
k. Include water treatment procedures and tests.

2. Each Electric and Electronic System:
a. Provide description of system and component parts including:
(1). Function, normal operating characteristics and limiting conditions.
(2). Performance curves, engineering data and tests.
(3). Complete nomenclature and catalog number of replaceable parts.
b. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.
c. Include color coded wiring diagrams.
d. Operating Procedures: Include start-up, break-in, and routine and normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
e. Maintenance Procedures: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
f. Include manufacturer's printed operating and maintenance instructions.
g. Provide list of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.
h. Electrical coordination study.
i. Special systems wiring diagrams.

3. Include warning of detrimental maintenance practices.
4. Prepare and include additional data when need for such data becomes apparent during instruction of Owner's personnel or as required under pertinent Specification Sections.

E. SUBMITTALS:
1. Submit completed manuals to A/E for review and transmittal to Owner’s Representative thirty plus (30+) days prior to Substantial Completion Inspection.
2. Submittal of operating and maintenance manuals shall be prior to instruction of Owner's operating and maintenance personnel.

1.4 MAINTENANCE INSTRUCTION

A. SUBMITTALS:
1. Submit preliminary copy of "Instruction of Owner's Operating and Maintenance Personnel" report for each system or item requiring instruction, on photocopy of form provided herein, at least 60 days prior to instruction date.
2. Submit fully completed forms upon completion of all instruction.

B. QUALITY ASSURANCE:
1. Instruction shall be done by personnel trained and experienced in maintenance of described products and operation of described equipment and systems, and familiar with requirements of this Section.

C. SCHEDULING:
1. Do not perform instruction until systems and equipment have been inspected and approved.
2. Complete all instruction prior to Substantial Completion.

D. INSTRUCTION OF OWNER'S PERSONNEL:
1. Instruct Owner's designated personnel in operation and maintenance of systems and

equipment. Use Operating and Maintenance Data specified in this section as basis for instruction.

2. Furnish specialized tools required to operate and maintain systems and equipment for Owner's use.
3. Provide level of instruction commensurate with system or item requiring instruction. Some items may require multiple training sessions at different times due to Owner's 24 hours per day operation.
4. Explain contents and use of Operation and Maintenance Data.
5. Explain operating sequences as follows:
    a. Show location and operation of switches, valves and other such devices used to start, stop and adjust systems.
    b. Explain use of flow diagrams, operating sequence diagrams and other such devices.
    c. Demonstrate operation through complete cycles and full range of operation through all modes, including testing and adjusting relevant to operation.
6. Explain use of control equipment, including temperature settings, switch modes, available adjustments, reading of gauges, and functions that must be serviced by factory-authorized representatives.
7. Explain trouble-shooting procedures; demonstrate problems which commonly occur, and their resolution, and note procedures which must be performed by factory authorized personnel.
8. Explain maintenance procedures and requirements, including items requiring periodic maintenance. Demonstrate preventive maintenance procedures and recommended maintenance intervals. Demonstrate other maintenance procedures not part of periodic maintenance program. Identify maintenance materials to be used.

1.5 MAINTENANCE MATERIALS

A. GENERAL:

1. Assemble spare parts and maintenance materials as required in individual Specification Sections. Deliver in clean packaging identified with manufacturer's name, trade name, stock number, size, color, and other similar information identifying products. Identify building and location in building where item is used or with what it is used. Include name, address and telephone number of local supplier.
2. Deliver to Owner’s Representative, prior to Final Inspection, at a location within three (3) miles of Project Site as directed by Owner’s Representative. Include a letter of transmittal with delivery with a copy to A/E listing materials provided.

1.6 WARRANTIES

A. WARRANTY SUBMITTAL:

1. Warranty Format: Assemble warranties executed by respective manufacturers, suppliers, subcontractors and Contractor as follows:
    a. Size: 8-1/2" x 11". Punch sheets for 3-ring binder; fold larger sheets to fit into durable binders.
    b. Cover: Identify each packet with type or printed title "WARRANTIES". List title of Project and name of Contractor.
    c. Table of Contents: Neatly typed, using table of contents of Project Specification as format.
    d. Procedures to be followed in case of failure.
    e. Quantity: Provide two (2) sets.
2. Warranty Forms: Except as otherwise specified, Contractor shall execute in duplicate on Contractor's letterhead, the Project Warranty for General Construction and special Warranties required by various Specification Sections, on the warranty forms which follow at end of this Section.

3. Warranty Effective Date:
    a. For portions of Work accepted by Owner prior to Final Completion: Date of Substantial Completion and Early Occupancy.
    b. For portions of Work accepted by Owner at Final Completion: Date of Substantial Completion or Final Completion whichever occurs sooner.

B. PREPARATION
1. Obtain warranties and guarantees, executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten (10) days after completion of the applicable item or work. Except for items put into service with Owner's permission, warranty begins with date of Substantial Completion in accordance with Uniform General and Supplementary Conditions.
2. Verify that documents comply with requirements of Contract Documents, are in form approved by Owner, contain full information. As a minimum, each warranty shall contain:
    a. Name and location of Project.
    b. Name and address of Contractor.
    c. Product or work item.
    d. Scope of warranty.
    e. Date of beginning and duration of correction period for warranty.
3. Retain warranties until time specified for submittal.

C. TIME OF SUBMITTALS
1. For equipment or component parts of equipment put into service with Owner's permission, submit documents within ten (10) days after acceptance.
2. Make other submittals within ten (10) days after Date of Substantial Completion, prior to Final Application for Payment.

D. SCHEDULE OF SUBMITTALS
1. Refer to Sections “Submittal Procedures” and “Shop Drawings, Product Data and Samples” for Schedule of Submittals.

E. WARRANTY ADMINISTRATION
1. A representative of the User (usually the Physical Plant Director) will be the Owner's point of contact for all warranty work. When disagreements develop between the Warranty Administrator and the Warrantor, the Director of Project Delivery, FPC will act for the User.

1.7 PROJECT RECORD DOCUMENTS

A. GENERAL:
1. Maintain at the Site for the Owner one record copy of:
    a. Drawings,
    b. Specifications,
    c. Addenda,
    d. Change Orders and other modifications to the Contract,
    e. A/E's field orders and other written instruction,
    f. Approved shop drawings, product data, and samples,
    g. Field test records,
    h. Other records required throughout construction by Owner’s Representative.
2. Maintenance of Record Documents and Samples:
    a. Store documents and samples in Contractor's field office apart from documents used for construction. Provide files and racks for storage of documents. Provide locked cabinet or secure storage space for samples.
    b. File documents and samples in accordance with Drawing Index and Specification

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c. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
d. Make documents and samples available at all times for inspection by A/E and Owner's Representative.
e. Record Prints will be reviewed monthly by the Owner's Representative and A/E. This will be a requirement for issuance of a Certificate for Payment.

B. RECORDING

1. Label each document and each sheet of the record drawing set as constructed, "As Constructed" in stamped or printed letters.
2. Record information concurrently with construction progress. Make entries within 24 hours after receipt of information. Do not cover-up items required to be shown on Project Record Documents until recorded.
3. Utilize skilled draftspersons to make neat legible notations on record documents to record actual construction as follows:
   a. Location of underground utilities and appurtenances covered by construction, referenced by an elevation and dimension to visible and accessible features of structure.
   b. Location of internal utilities and appurtenances covered by construction, referenced by elevation and dimension to visible and accessible features of structure.
   c. Indicate field changes of dimension and detail, changes made by field order or Change Order, and details not on Contract Drawings.
   d. Record actual CFM rating in each space on Mechanical Drawings.
   e. In Specifications and Addenda, record manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed, changes made by Change Order, approved substitution, or other modification, and other matters not originally specified.
4. Entries: Clearly describe change by note and by graphic line, as required. Date all entries. Call attention to entry by "cloud" around area or areas affected. In event of overlapping changes, use different color for each change.
5. Owner's Representative and A/E will review Record Set monthly. If documents are not being maintained concurrently with construction progress, Owner may withhold progress payments until documents are made current.

C. SUBMITTAL

1. Prior to Final inspection and as a prerequisite to Final Payment, submit Record Document drawings, including mechanical, electrical and plumbing installations, and other installations as specified in Contract Specifications, to A/E for permanent Project File.
2. Documents shall be submitted at one time with transmittal letter containing date, Project title, Contractor's name and address, itemized list of documents, and signature of Contractor. The Contractor's signature acknowledges that the documents have been reviewed and that they represent a true and accurate record of the work installed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01780

INSTRUCTION OF OWNER'S OPERATING PERSONNEL

PROJECT: _____
_____
_____
Project No. _____
Contract No. _____

SYSTEM OR EQUIPMENT: _____

PRELIMINARY INFORMATION:

A. To be completed by Contractor:

1. Proposed dates of instruction: _____ to _____
2. Representative performing instruction: _____
3. Number of hours required: _____

B. To be completed by Owner:

1. Owner's personnel to be instructed:

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

INSTRUCTION LOG:

Date	No. of Hours	Materials Covered	Instructor's Initials	Owner's Rep. Comments Initials

Total Hours: _____ Date Instruction Completed: _____

Owner's Representative: _____
Instructor: _____

PROJECT WARRANTY FOR GENERAL CONSTRUCTION

WHEREAS, _____(Contractor),

Address _____

Telephone ( ) _____has performed general construction work on the following project:

_____

_____

Contract No. _____ Project No. _____

For _____(Owner),

Address _____, and,

WHEREAS, Contractor has agreed to warrant said Work to be new, unless otherwise specified in the Contract Documents, and that all Work is of good quality, free from faults and defects, and in accordance with the Contract Documents.

NOW THEREFORE, Contractor hereby warrants said Work in accordance with terms hereof, complying with terms of Contract with Owner dated _____, 20_____, that:

Contractor agrees to repair or replace to the satisfaction of the Owner all Work that may prove defective in workmanship or materials together with all other Work which may be damaged or displaced in so doing, except for abuse, modifications not executed by Contractor, insufficient maintenance, improper operation, or normal wear and tear under normal usage.

All repairs or replacements shall have a correction period for such Work equal to the original correction period as herein stated, dated from the final acceptance of repairs or replacement.

CORRECTION PERIOD FOR THE WORK: STARTING _____, TERMINATING _____.

In the event of our failure to comply with the above mentioned conditions within a reasonable time after being notified in writing, we hereby authorize the Owner to proceed to have defects repaired and made good at our expense, and we will pay the costs and charges therefore immediately upon demand.

IN WITNESS THEREOF, this instrument has been duly executed this ___day of _____, 20_____, for Contractor by _____
(Signature)

_____as its _____.
(Typed Name) (Title)

SPECIAL WARRANTY FOR _____

WHEREAS, _____(Contractor),

Address _____

Telephone ( ) _____has performed _____

work on the following project: _____,

Contract No. _____ Project No. _____

For _____(Owner),

Address _____, and,

WHEREAS, Contractor has agreed to warrant said Work to be new, unless otherwise specified in the Contract Documents, and that all Work is of good quality, free from faults and defects, and in accordance with the Contract Documents.

NOW THEREFORE, Contractor hereby warrants said Work in accordance with terms hereof, complying with terms of Contract with Owner dated _____, 20___, that:

Contractor agrees to repair or replace to the satisfaction of the Owner all Work that may prove defective in workmanship or materials together with all other Work which may be damaged or displaced in so doing, except for abuse, modifications not executed by Contractor, insufficient maintenance, improper operation, or normal wear and tear under normal usage.

All repairs or replacements shall have a correction period for such Work equal to the original correction period as herein stated, dated from the final acceptance of repairs or replacement.

CORRECTION PERIOD FOR THE WORK: STARTING _____, TERMINATING _____.

In the event of our failure to comply with the above mentioned conditions within a reasonable time after being notified in writing, we agree to hereby authorize the Owner to proceed to have defects repaired and made good at our expense, and we will pay costs and charges therefore immediately upon demand.

IN WITNESS THEREOF, this instrument has been duly executed this ___day of _____, 20___
for Contractor by _____
(Signature)

_____as its _____.
(Typed Name) (Title)

And has been countersigned in accordance with terms and conditions, for

Installer by: _____ _____
(Signature) (Typed Name)

as its _____.
(Title)

Name of Firm _____

Address _____

SECTION 07 84 00

FIRESTOPPING

PART 1- GENERAL

1.1 SECTION INCLUDES

A. Firestopping materials.

B. Firestopping of all penetrations and interruptions to fire-rated assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 REFERENCES

A. ASTM E 814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2000.

B. ITS (DIR), Directory of Listed Products; Intertek Testing Services NA, Inc. current edition.

C. FM P7825, Approval Guide; Factory Mutual Research Corporation; current edition.

D. UL (FRD), Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

2.1 SUBMITTALS

A. Schedule of Firestopping: List each type of penetration.

B. Product Data: Provide data on product characteristics.

C. Manufacturer=s Installation Instructions: Indicate preparation and installation instructions.

D. Manufacturer=s Certificate: Certify that products meet or exceed specified requirements.

1.1 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated.
   1. Listing in the current classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
   2. Current evaluation reports published by CABO, ICBO, or BOCA will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three (3) years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years experience.

1.2 MOCKUP

A. Install one firestopping assembly representative of each fire rating design required on project.
   1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
   2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft.

B. If accepted, mockup will represent minimum standard for the Work.

C. If accepted, mockup may remain as part of the Work. Remove and replace mockups not accepted.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Comply with firestopping manufacturer=s recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for three (3) days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2- PRODUCTS

2.1 FIRESTOPPING ASSEMBLIES

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use any system listed by UL or tested in accordance with ASTM E 814 that has F rating equal to fire rating of penetrated assembly, and minimum T rating equal to F rating and that meets all other specified requirements.

2.2 MATERIALS

A. Elastomeric Silicone Firestopping: Single-component silicone elastomeric compound and compatible silicone sealant, conforming to the following:
   1. Durability and Longevity: Permanent.
   2. Color: Dark grey.
   3. Manufacturers:
      a. A/D Fire Protection Systems Inc.
      b. Hilti, Inc.
      c. 3M Fire Protection Products.
      d. Specified Technologies, Inc.

B. Foam Firestopping: Single-component foam compound, conforming to the following:
   1. Durability and Longevity: Permanent.
   2. Color: Dark grey.
   3. Manufacturers:
      a. Hilti, Inc.
      b. 3M Fire Protection Products.
      c. Specified Technologies, Inc.

C. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers, conforming to the following:
   1. Durability and Longevity: Permanent.
   2. Color: Dark grey.
   3. Manufacturers:
      a. A/D Fire Protection Systems Inc.

b. Hilti, Inc.
c. USG Corporation.

D. Fiber Packing Material: Mineral fiber packing insulation, conforming to the following:
1. Durability and Longevity: Permanent.
2. Manufacturers:
a. A/D Fire Protection Systems Inc.
b. Hilti, Inc.
c. Pecora Corporation.
d. USG Corporation.

E. Firestop Devices: Mechanical device with incombustible filler and sheet stainless steel jacket, conforming to the following:
1. Durability and Longevity: Permanent; suitable for pedestrian traffic.
2. Manufacturers:
a. Grace Construction Products.
b. Hilti, Inc.
c. 3M Fire Protection Products.
d. Specified Technologies, Inc.

F. Intumescent Putty: Compound which expands on exposure to surface heat gain, conforming to the following:
1. Potential Expansion: Minimum 1000 percent.
2. Durability and Longevity: Permanent.
3. Color: Dark grey.
4. Manufacturers:
a. Grace Construction Products.
b. Hilti, Inc.
c. 3M Fire Protection Products.
d. Specified Technologies, Inc.

G. Firestop Pillows: Formed mineral fiber pillows, conforming to the following:
1. Durability and Longevity: Permanent.
2. Manufacturers:
a. Grace Construction Products.
b. Hilti, Inc.
c. Nelson Firestop Products.
d. Specified Technologies, Inc.

H. Primers, Sleeves, Forms, and Accessories: Type required for tested assembly design.

PART 3- EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.

B. Remove incompatible materials which may affect bond.

C. Install backing materials to arrest liquid material leakage.

3.3 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer=s instructions, completely closing openings.

B. Install labeling required by code.

3.4 CLEANING AND PROTECTION

A. Clean adjacent surfaces of firestopping materials.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 23 00 05

MECHANICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Demolition and removal of selected portions of building or structure.
   2. Demolition and removal of selected site elements.
   3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove or Demolish: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner cleaned, packaged, and ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
   1. Coordinate with Owner's representative, who will establish special procedures for removal and salvage.

1.4 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
   2. Interruption of utility services. Indicate how long utility services will be interrupted.
   3. Coordination for shutoff, capping, and continuation of utility services (including but not limited to: Gas, Water, Fire Suppression, Chilled Water, Hot Water, Air Conditioning, etc).
   4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
   5. Means of protection for items to remain and items in path of waste removal from building.

B. Inventory: After selective demolition is complete, submit a list of items that have been salvaged.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI A10.6 and NFPA 241.

C. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Section “Project Management and Coordination.” Review methods and procedures related to selective demolition including, but not limited to, the following:
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
   5. Review areas where existing construction is to remain and requires protection.

1.6 PROJECT CONDITIONS

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

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.
   1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

B. Service/ Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Arrange to shut off indicated utilities with utility companies.
   2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
      a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
   3. Maintain adequate ventilation when using cutting torches.
   4. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

E. Contractor shall terminate demolished pipe and/or ductwork. System shall be capped and insulated per new work specification.

F. Contractor shall remove any abandoned piping and/or ductwork in area of construction during the demolition process.

G. Unforeseen Conditions
   1. Any unforeseen utilities found during construction that directly affect any trade must be brought to the engineer’s attention via RFI.
   2. All existing conditions must be clearly annotated on the As-Built drawings.

H. Repair any walls, floors or roofs that piping, ducts or equipment have been removed from (or through). Patch with similar materials to match finish and color (paint to match). If paint cannot be matched, repaint entire wall or surface.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 23 01 00

SPECIAL CONDITIONS FOR ALL MECHANICAL WORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section covers the general provisions of the mechanical specifications applicable to the following systems:
   1. Heating, air conditioning, and ventilation.

B. The use of the word mechanical in the body of the various specifications sections shall be interpreted to include all the aspects of all of the systems referenced in Mechanical Specifications.

1.2 DRAWINGS

A. These specifications are accompanied by drawings of the building and details of the installations showing the locations of equipment, piping, ductwork, etc. The drawings and these specifications are complementary to each other; requirements described in one or the other shall be considered binding as if described in both.

B. If any departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Owner's Representative for approval. No departures shall be made without prior written approval by the Owner's Representative.

C. There are intricacies of construction which are impractical to specify or indicate in detail; means and methods for performing such work shall adhere to commonly accepted industry standards.

D. It is the Contractor's responsibility to properly use all information found on the Architectural, Structural, Mechanical, and Electrical drawings and applicable shop drawings where such information affects his work.

E. For new buildings, all final dimensions shall be scaled from the Architectural drawings, unless otherwise noted. For work associated with existing buildings (renovations and additions), all final dimensions shall be field verified.

1.3 CONSTRUCTION REQUIREMENTS

A. The architectural, civil, structural, electrical, plumbing, fire protection and mechanical drawings, and specifications are all part of the Contract Documents. In many instances there are details described on another trade=s drawings that are not necessarily included or referenced in the mechanical drawings. It is the Contractor=s responsibility to review in detail all parts of the Contract Documents prior to submitting a bid. Failure to comply with this requirement shall not relieve the Contractor of responsibility or be used as cause for additional compensation because architectural, structural, or electrical details were not included in the mechanical drawings.

B. It is the intent of the Contract Documents to provide complete and fully functional installation in every respect. Material and/or construction details not specifically described in the

Contract Documents, but commonly considered incidental to the industry, are required by the Contractor.

C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to comply with Codes, to facilitate the work of other trades, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated satisfactory operating installation.

D. The mechanical, electrical and plumbing drawings are schematic in nature and do not show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of ordinances and structural and architectural conditions.

E. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and above suspended ceilings, etc. in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid compromising structural members; therefore, inserts to accommodate hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to building lines unless otherwise noted.

F. When the mechanical drawings do not give exact details as to the elevation of pipe or ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping, exposed conduit, and duct systems are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The plans do not show all required offsets, control lines, pilot lines, and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain to insulate will not be permitted.

G. Final placement of serviceable equipment shall be carefully coordinated with all other trades to ensure sufficient clearance for maintenance according to manufacturer=s recommendations. Lubricating orifices and adjustable components shall be easily accessible. Piping, conduit, valve stems, cabling and other building systems shall not interfere with service space.

H. Location of Exposed Devices
   1. All exposed devices (grills, registers, diffusers, sprinkler heads, medical gas outlets, plumbing rough-ins, lights, outlets, communication devices, etcetera) shall be referenced to fixed data points that are coordinated with all trades; shall be located to present symmetrical arrangements with respect to the fixed data point; and shall facilitate the proper arrangements of acoustical ceiling tiles. Fixed data points shall include such features as wall and ceiling lines, soffits, balanced border widths, masonry joints, etc. Devices located in acoustical ceiling tiles shall occur symmetrically in tile joints or in the centers of whole tiles. The final determination of the exact location of each outlet and the arrangements to be followed shall be acceptable to the Owner=s Representative.
   2. The drawings schematically indicate locations of the exposed devices. Final locations shall be determined by carefully coordinating the drawings pertaining to each trade. Where conflicts are identified, Owner=s Representative shall determine final location. The Owner reserves the right to make any reasonable change in location of any device before installation, without additional cost.

1.4 QUALIFICATIONS

A. Contractor must have minimum of five years experience installing commercial heating, ventilation and air conditioning systems, plumbing and piping systems similar to those described in these Contract Documents.

B. Contractor must be licensed and hold a current contracting license that has been valid for a minimum of five years in the State of Texas.

C. Contractor must be able to bond work for payment and performance of work being bid. Contractor=s bonding agency shall have a Best=s insurance rating of A or A+.

1.5 MATERIAL AND EQUIPMENT REQUIREMENTS

A. Manufacturer=s Instructions: The manufacturer=s published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Owner=s Representative in writing of any conflict between the requirements of the Contract Documents and the manufacturer=s direction and shall obtain the clarification of the Owner=s Representative before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer=s directions or such clarification by the Owner=s Representative, he shall bear all costs arising in connection with the correction of the deficiencies.

B. Storage at Site: The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage and from surrounding work.

C. Capacities shall be not less than those indicated and shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.

D. Conformance to Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters Laboratories, Inc., ETL listed or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. The label of the Underwriters Laboratories, Inc. or ETL applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.

E. Nameplates: Each major component of equipment shall have the manufacturer=s name, address, and model-identification number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.

F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8 inch on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified, except that coal tar or asphalt-type coatings will not be acceptable unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.

G. Protection from Moving Parts: Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.

H. Drive Guards: For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears, and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory-fabricated air handling units casings. Guards shall be constructed of sheet steel, cast iron, expanded metal, or wire mesh rigidly secured so as to be removable without disassembling pipe duct or electrical connection to equipment. Provide a 1-inch diameter hole in each drive guard at each shaft center to allow access for speed measurement.

I. Verifications of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Owner=s Representative of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner, Architect, or Engineer.

J. Standard Products: Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.

K. Spare Parts Data: As soon as practicable after approval of materials and equipment and, if possible, not later than four months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies with current unit prices and sources of supply, a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified hereinafter to be furnished as part of the Contract, and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 120 days at the particular installation. The foregoing shall not relieve the Contractor of any responsibilities under the warranty specified.

1.6 INSPECTION OF THE SITE

A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil conditions, structures, utilities, equipment, systems, facilities, and local requirements. The submission of bids shall be deemed evidence of such visits. All proposals shall take these existing conditions into consideration, and the lack of specific information shall not relieve the Contractor of any responsibility.

1.7 UTILITY LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered separately from the Contract Documents, as a general guide only, without guarantee as to accuracy. Examine the site, the locations, and availability of all utilities and services required for their relation to the work. Verify the location of all existing site utilities with each responsible utility company or applicable party. The Contractor shall repair all damage to existing utilities, whether indicated on the drawings or not, at his sole expense.

1.8 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

A. Permitting Fees: Contractor shall pay for all fees associated with permits required by municipal authorities having jurisdiction.

B. Tapping and Impact Fees: Contractor shall pay for all fees associated with tapping into municipal utility mains, including sanitary sewer, natural gas and domestic water. Impact fees will be paid for by the Owner.

C. Compliance: The Contractor shall comply in every respect with all requirements of local authorities having jurisdiction, including building inspections, fire marshal, local ordinances and codes, and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these specifications and drawings where specified conditions are of a higher quality than the requirements of the above-specified authorities. Where requirements of the specifications and drawings are below the requirements of the above offices having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities.

D. Utilities: The Contractor shall coordinate with the various utility companies involved in this project and shall provide required utility relocations, extensions, modifications, and/or changes (complete in all respects) as described in the Contract Documents. Contractor shall verify the location of all existing utilities with the applicable Utility Company. The Contractor shall be responsible for all damages to existing utilities, whether indicated on drawings or not, and repair all damage to existing utilities as acceptable to the affected Utility Company.

E. Certification: Prior to final acceptance, the Contractor shall furnish a certificate of acceptance from the inspection departments having jurisdiction over the work for any and all work installed under this Contract. Any additional labor costs incurred as a result of a substitution shall be the Contractor=s responsibility.

1.9 EXISTING FACILITIES

A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection, and in-service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being performed under this project.

C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc. to provide this access and shall reinstall same upon completion of work in the areas affected.

D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction. This is to include but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, conduit, etc.

E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two weeks in order to schedule required outages. The time allowed for outages will not be during normal working

hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

1.10 DEMOLITION AND RELOCATION

A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner and shall be delivered to such destination or otherwise disposed of as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor=s responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

1.11 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. No substitution of materials or equipment herein specified or called for on the drawings will be permitted, except by written permission of the Owner=s Representative. Where several makes of equipment or material are mentioned, any item named may be bid upon provided it meets space, capacity specifications, and other requirements.

1.12 SUBMITTALS

A. Submittals for Review:
   1. As soon as practical or within 30 days after the date of contract award or notice to proceed, and before purchasing or starting installation of any materials or equipment, the Contractor shall submit for review sufficient material and equipment data to indicate that all requirements of the specifications have been met and samples shall be furnished when requested. All manufacturer=s data used as part of the submittal shall have all non-applicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.

2. Four (4) copies of the submittal list and detailed submittals (for the Owner=s and A/E=s use) shall be submitted to the Owner=s Representative. The Contractor is requested to include a minimum of three (3) additional copies for insertion in the project=s Owner=s Manuals at the completion of the project, and the number of additional copies the Contractor requires for his and his subcontractor=s use during the project=s construction. The detailed submittals shall be accompanied by the same number of sets of pictorial and descriptive data derived from the manufacturer=s catalogs and sales literature or incorporated in the shop drawings. The Contractor may provide a detailed submittal on any item even though not required by the Owner=s Representative.

B. Format
   1. Submittals shall be in pdf format. The first page shall have a cover sheet inserted with the title AMECHANICAL SUBMITTALS@ centered in large print. Below the title shall be printed the name of the project, the date, the project location, the name and address of the contractor, the name and address of the subcontractor and the name and address of the engineer(s) in smaller print.
   2. Provide a Table of Contents at the beginning of the binder that summarizes the information being submitted according to specification section.
   3. Submittals shall be tab divided by specification section; **all sections** identified in the project specifications shall have a tab. When no information is being provided concerning a particular specification section, insert a single dated sheet that explains the circumstances.
   4. **Loose-leaf or piecemeal submittals are not acceptable and subject to rejection unless prior approval has been granted by the Engineer.**

C. Content:
   1. The Contractor shall prepare or cause to be prepared shop drawings, product data, materials and equipment lists, diagrams, data, samples, and other submittals as required by the contract documents, hereinafter referred to as ASubmittal Data.@ The Contractor shall review and approve all submittal data for compliance with the contract documents, manufacturer=s recommendations, adequacy, clearances, code compliance, safety, and coordination with associated work.
   2. The Contractor shall submit approved submittal data to the Owner=s Representative for review and comment as to general conformance with the design concept and general compliance with information given in the contract documents. Owner=s Representative=s review shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with other trades or work, or construction safety and precautions, all of which are the sole responsibility of the Contractor.
   3. The Contractor shall clearly and specifically identify and call to the attention of the Owner=s Representative any deviation from the contract documents for which Owner acceptance is desired. The responsibility for such a deviation accepted by the Owner shall remain with the Contractor.
   4. Timeliness: The burden of timeliness in the complete cycle of submittal data is on the Contractor. The Contractor shall allow a minimum of four (4) weeks= time frame for review of each submission by the Owner=s Representative. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all re-submission cycles on nonconforming materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not justify any request for scheduled construction time extensions or extra compensation.
   5. Work performed in accordance with approved submittal date that is not in accordance with the Contract Documents and did not have the specific acceptance of the Owner=s Representative shall be replaced at Contractor=s cost.

D. Re-submittals

1. Re-submit entire submittal in accordance with afore mentioned format and content requirements. **Loose-leaf or piecemeal re-submittals are not acceptable.** New and/or revised data for each section shall be prefaced with a colored (yellow, pink, orange, etc) cover sheet that identifies (in a word or two) the materials and/or equipment being re-submitted. Typeset the words AREVISED SUBMITTAL NO. 1 (or 2, 3 as applicable)@ centered at the bottom of the cover sheet.
2. Subsequent re-submittals (second and third, if necessary) shall have different colored cover sheets to distinguish between the various re-submittals.
3. Include a cover letter at front of binder that specifically responds to each AREVISE AND RE-SUBMIT COMMENT@ or AREJECTED@ comment by number. Example responses would include the following:
   a. RESPONSE: APlease see attached re-submittal.@
   b. RESPONSE: AWill be re-submitted at a later date.@
   c. RESPONSE: ARequirement for (xxxxxx) was deleted in Addendum No. 2.@
   d. RESPONSE: AException requested based on Section xx, Paragraph x.x.x.

E. These paragraphs related to Mechanical submittal data supersede any conflicting requirements contained in Division 01 sections.

1.13 CONTRACTOR CERTIFICATION OF SUBMITTAL DATA

A. The Contractor shall provide the following certification with all submittal data furnished to the Owner=s Representative for review and comment.

Project Title:

Description of Submittal Data:

This is to certify that the above-described submittal data has been reviewed and is approved for compliance with the Contract Documents, manufacturer=s recommendation, adequacy, clearances, code compliance, safety, and coordination with other trades and/or work except as follows: (list Anone@ or itemize and explain). In addition, the Contractor shall submit to the Owner=s Representative a signed statement from each representative certifying as follows:

AI certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer=s representative and is properly installed and operating in accordance with the manufacturer=s recommendations and are asbestos free.@

_____

Name and Company

1.14 ACCEPTANCE OF MATERIALS AND EQUIPMENT

A. All equipment installed on this project shall have **local (within 125 miles)** representation, local factory-authorized service, and a local stock of repair parts. This requirement is essential and will be strictly reviewed by the Owner=s Representative prior to concurrence with the Contractor=s approval for all submittals covered by Mechanical sections of this Specification.

B. NOTICE: The Contractor is responsible for providing materials and equipment that conform to the requirements of the project manual in every respect unless a deviation has been Aaccepted@ in writing. Removal of any nonconforming materials and equipment and the

replacement with conforming materials and equipment shall be at the Contractor=s sole expense, regardless of when nonconformance was discovered.

C. Approval of materials and equipment shall be based on manufacturer=s published data and shall be tentatively subject to the submission of complete shop drawings which comply with the contract documents. Approval is also dependent upon the existence of adequate and acceptable clearances for entry, servicing, and maintenance.

D. Approval of materials and equipment under this provision shall not be construed as authorizing any deviations from the specifications, unless the attention of the Owner=s Representative has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

E. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of approved manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

1.15 SHOP DRAWINGS

A. As soon as practicable after the award of contract and approval of materials and equipment, but prior to installation, complete and detailed shop drawings of the following shall be submitted for review and comment:
1. Equipment arrangements.
2. Duct layouts.
3. Piping layouts.
4. Layouts of equipment spaces indicating ductwork and piping larger than 2 inches.
5. Typical fittings and connections.
6. Equipment foundations.
7. Factory-fabricated equipment and materials.
8. Anchors.
9. Control.
10. Interlock.
11. Sprinkler locations.
12. Other details as directed by the Owner=s Representative. Composite drawings of areas requiring coordination between trades shall be provided and expedited to eliminate conflicts and to ensure maximum cooperation and work progress.

B. Work performed without benefit of reviewed and approved shop drawings **will not be recommended for payment by the Engineer** until such time as the shop drawings are submitted, reviewed, and approved. Any work performed without the benefit of reviewed and approved shop drawings may require removal, relocation, and/or replacement at the Contractor=s sole expense in order to resolve conflicts between the various systems and provide the performance specified.

C. All installation of equipment, fixtures, terminal devices, etc. shall be made in accordance with approved composite shop drawings. The Contractor shall modify installation and relocate installed work to provide code clearances, service access, and eliminate conflict with other systems.

D. Submit one print of shop drawings for each area, floor, system, etc. The print will be marked with the A/E=s comments and returned to the Contractor. Contractor shall revise shop drawings, incorporate revisions in field and submit revised shop drawings at project close out.

1.16 SITE OBSERVATION

A. Site observation by the Architect, Engineer, and/or Owner=s Representative is for the express purpose of verifying compliance by the Contractor with the contract documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.17 SUPERVISION

A. In addition to the Superintendent required under the conditions of the contract, each subcontractor shall keep a competent superintendent or foreman on the job at all times.

B. It shall be the responsibility of each superintendent to study all plans and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and, before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the jobsite by the superintendents involved. Where interferences cannot be resolved without major changes to the plans, the matter shall be referred to the Owner=s Representative for comments.

1.18 OPERATION PRIOR TO COMPLETION

A. When any piece of mechanical equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation and has the written permission of the Owner=s Representative to do so. The warranty period shall not commence, however, until such time as the equipment is operated for the beneficial use of the Owner or date of substantial completion, whichever occurs first.

B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and the start of the warranty may not be the same date.

1.19 MANUFACTURER=S RECOMMENDATIONS

A. The manufacturer=s published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material. The Contractor shall promptly notify the Owner=s Representative, in writing, of any conflict between the requirements of the contract documents and the manufacturer=s directions, and shall obtain the Owner=s Representative=s comments before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer=s directions or applicable comments from the Owner=s Representative, he shall bear all costs arising in connection with the correction of such deficiencies.

1.20 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

A. Before final acceptance of the work, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of his materials and/or equipment to determine that it is properly installed and in proper operating order. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise. In addition, the Contractor shall submit to the Owner=s Representative a signed statement from each representative certifying as follows:

AI certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer=s representative and is properly installed and operating in accordance with the manufacturer=s recommendations and are asbestos free.@

B. Check inspections shall include plumbing, heating, air conditioning, ventilating, mechanical control and electrical equipment, and such other items hereinafter specified or specifically designated by the Owner=s Representative.

1.21 OPERATING AND MAINTENANCE INSTRUCTION

A. The Contractor shall prepare for the owner=s manual hereinafter specified complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc. for each item of equipment. These are to be assembled as hereinafter specified for owner=s manual.

B. In addition, the Contractor shall provide the service of a competent engineer or a technician acceptable to the Owner=s Representative to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of sufficient duration to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, acknowledged by the Owner, stating the dates of instruction and personnel to whom instructions were given.

C. Additional diagrams, operating instructions, etc. shall be provided as specified hereinafter in the other sections of these specifications.

1.22 MATERIAL AND EQUIPMENT SCHEDULES

A. Contractor shall refer to both drawings and specification for schedules. Where reference is made to items Ascheduled on drawings@ or Ascheduled in specifications,@ same shall include schedules contained in both the drawings and the specifications. The Contractor=s attention is directed to the various specification sections and drawings for schedules.

1.23 APPLICABLE CODES AND STANDARDS

A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these specifications, except as may be hereinafter specifically modified in these specifications and associated drawings.
   1. National Fire Protection Association Standards (NFPA):
      NFPA 10 - Portable Fire Extinguishers
      NFPA 54 - National Fuel and Gas Code
      NFPA 70 - National Electrical Code
      NFPA 90A - Air Conditioning Systems
      NFPA 101 - Life Safety Code
      NFPA 255 - Method of Test of Surface Burning Characteristics of Building Materials
   2. American National Standards Institute (ANSI):
      15-78 - Safety Code for Mechanical Refrigeration
      C.2 - 1984 National Electrical Safety Code
      A117.1 - Handicapped Code
   3. American Society of Mechanical Engineers (ASME): Section IV, V, CSD-1
   4. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these specifications.
   5. American Water Works Association (AWWA): All applicable manuals and standards.
   6. Sheet Metal and Air Conditioning Contractors National Associate, Inc, (SMACNA): All applicable manuals and standards.

7. Air Moving and Conditioning Association (AMCA): All applicable manuals and standards.
8. American Society of Testing Materials (ASTM): All applicable manuals and standards.
9. National Electrical Manufacturers= Association (NEMA): All applicable manuals and standards.
10. Occupational Safety and Health ACT (OSHA):
National Sanitation Foundation - Standard No. 2
11. American Society of Heating, Refrigeration, and Air conditioning Engineers (ASHRAE):
ASHRAE 90.1
12. Americans with Disabilities Act, 1990
13. American Gas Association (AGA)
14. Underwriters Laboratories, Inc. (UL)
15. Manufacturer=s Standardization Society of the Valve and Fitting Industry (MSS)
16. Applicable Local and State Building Codes (International Building Codes, as amended):
17. Applicable Local and State Mechanical Code (International Mechanical Code, as amended).
18. Applicable Local and State Plumbing Code (International Plumbing Code, as amended).
19. Applicable Local and State Energy Code (International Energy Conservation Code, as amended).
20. Applicable State Gas Code (International Fuel and Gas Code, as amended).

B. All materials and workmanship shall comply with all applicable city, state, and national codes, specifications, and industry standards. All materials shall be listed by the Underwriters Laboratories, Inc. as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.

C. The contract documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Owner=s Representative in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 1 of these contract documents, providing no work or fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules, and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.24 DEFINITIONS

A. Refer to the condition of the contract for Division 1 for additional requirements regarding definitions.

B. Where Aas required@ or Aas necessary@ is used in these specifications or on the drawings, it shall mean Athat situations exist that are not necessarily described in detail or indicated that may cause the Contractor certain coordination requirements in performing the work described or indicated. These coordination requirements entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result.@

C. Where Aand/or@ is used in these specifications or on the drawings, it shall mean Athat situations exist where either one or both conditions occur or are required and shall not be interpreted to permit an option on the part of the Contractor.

1.25 FINAL INSPECTION

A. Refer to Division 1 for additional requirements for final inspection.

B. It shall be the responsibility of the Contractor to personally conduct a careful inspection, assuring himself that the work on the project is ready for final acceptance and developing his own Apunchlists,@ before calling upon the Owner=s Representative to make a final inspection. Failure of the Contractor to conduct such inspections and provide the Owner=s Representative with a copy of his Apunchlists@ prior to the final inspection shall be adequate cause for the Owner=s Representative to cancel any Contractor-requested final inspection.

C. In order not to delay final acceptance of the work, the Contractor shall conduct his own Afinal inspections@ prior to requesting the Owner=s Representative to Afinal@ the project; will have all necessary bonds, guarantees, receipts, affidavits, etc. called for in the various articles of this specification prepared and signed in advance; and together with a letter of transmittal listing each paper included, shall deliver the same to the Owner=s Representative at or before the time of said final inspection. The Contractor is cautioned to check over each bond, receipt, etc. before preparing same for submission to see that the terms check with the requirements of the specifications.

D. The final inspection will be made jointly by the Owner=s Representative and the Owner.

1.26 REQUIREMENTS FOR FINAL ACCEPTANCE

A. Requirements for final acceptance shall include but not be limited to the Contractor accomplishing the following:
   1. Construction: Complete all construction.
   2. Deficiency Lists: Correct all deficiencies listed at time of Substantial Completion.
   3. Owner=s Manual: Submit at least 30 days prior to final acceptance on (1) copy of the owner=s manual for the Owner=s Representative=s review and comments. Following acceptance, prepare three (3) copies of bound and indexed owner=s manual, to be delivered at the time of final acceptance, which shall include but not be limited to the following:
      a. System operating instructions.
      b. System control drawings.
      c. System interlock drawings.
      d. System maintenance instructions.
      e. Manufacturers=, suppliers=, and subcontractors= names, addresses, and telephone numbers, both local representatives and manufacturers= service headquarters.
      f. Equipment operating and maintenance instructions and parts lists.
      g. Manufacturer’s certifications (see Checking and Testing Materials and/or Equipment, this section).
      h. Contractor=s warranty.
      i. Acceptance certificates of authorities having jurisdiction.
      j. Log of all tests made during course of work.
      k. Owner=s acknowledgment of receipt of instruction, enumerating items in owner=s manual.
      l. List of manufacturers= guarantees executed by the Contractor.
      m. Certified performance curves.
      n. Balance and performance test reports.
      o. Owner=s acknowledgment of items of equipment or accessories indicated or specified to be turned over to Owner.
   4. Instructions:
      a. Verbal, as herein specified.
      b. Posted, framed under glass or plastic laminated:

1) System operating instructions.
2) System control drawings.
3) System interlock drawings.

5. Record Drawings: Deliver the specified record drawings to the Owner=s Representative.

1.27 RECORD DRAWINGS

A. The Contractor shall maintain a set of contract drawings (black-line prints) at the jobsite on which he shall indicate the installed (as-built) locations of the following:
   1. Equipment
   2. Main lines of piping and ductwork.
   3. Dimensional locations (including depth) of all underground piping, valves and conduits.

B. Drawings shall be used for construction reference and shall not leave the field office of the jobsite.

C. Drawings shall include all addenda, ASI=s, Change Orders, and existing conditions and equipment that are not reflected in the original contract drawings.

D. Upon completion of work, the Contractor shall obtain CAD files of the contract drawings from the Owner=s Representative and transfer the above as-built information into these files. The as-built files shall be permanently marked ARECORD DRAWINGS@ and printed on full-size Mylar sheets. Upon completion, the CAD files shall be transferred to CD in AutoCAD 2007 format. Both the CAD files CD and Mylar drawings shall be submitted to the Owner=s Representative as part of the Close-out Submittals.

E. Refer to Division 1 paragraph entitled ARecord Documents@ for additional requirements.

1.28 ALLOWANCES

A. Refer to Division 1 for allowances.

1.29 ALTERNATE PROPOSALS

A. Alternate proposals are summarized in Division 1 and on the bid proposal form. Refer to all sections of the specifications and the drawings to determine the exact extent and scope of the various alternate proposals as each pertains to the work of the various trades.

1.30 WARRANTY

A. General: All work performed (including equipment and materials furnished) under the various sections of these specifications shall be 100% warranted, for a period of one (1) year from the date of final acceptance thereof, against defective materials, design, and unauthorized substitution. Upon receipt of note of failure of any part of the guaranteed equipment and/or facilities during the guaranty period, the affected part(s) or facilities shall be replaced promptly with new parts, etc. by and at the expense of the Contractor. Further, the Contractor shall properly obtain, execute, and forward any and all manufacturer=s warranties on equipment furnished under the Contract. Refer to Division 1 for additional requirements.

B. Extended Period: The Contractor shall provide all extended time warranties available from the manufacturer of the equipment provided as standard at no additional cost. This includes all extended warranties where specified with certain equipment as directed in other sections of this Specification.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

A. All materials, unless otherwise specified, shall be current United States manufacture, new, free from all defects, and of the best quality. Foreign goods specifically approved for use by the Owner=s Representative prior to bidding may be furnished.

B. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, precise appearance.

C. The responsibility for the furnishing and installation of the proper mechanical equipment and/or material as intended rests entirely upon the Contractor. The Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

2.2 FLAME SPREAD AND SMOKE DEVELOPED PROPERTIES OF MATERIALS

A. Duct coverings, duct linings, vapor barrier facings, tapes, adhesives, core materials, insulation, jackets, piping (of any sort), and other materials in concealed locations, including any above-ceiling area, shall have a flame spread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating no higher than 50. Flame spread and smoke developed ratings shall be in accordance with NFPA Standard No. 255.

2.3 BEARINGS

A. All ball bearings shall be of radial and/or thrust type and enclosed in a dust and moisture-proof housing.

2.4 MOTORS

A. The Contractor shall provide all motors required for equipment supplied under each portion of the work. Motors shall be premium efficiency and be built in accordance with the latest ANSI, IEE, and NEMA standards, shall be fully coordinated with the equipment served, shall be of sizes and electrical characteristics scheduled.

2.5 STARTING EQUIPMENT

A. Each motor shall be provided with proper starting equipment. This equipment, unless hereinafter specified or scheduled to the contrary, shall be provided by the trade furnishing the motor. All motor starting equipment provided by any one trade shall be of the same manufacture unless such starting equipment is an integral part of the equipment on which the motor is mounted.

2.6 LOW VOLTAGE (CONTROLS/THERMOSTAT) WIRING

A. All low voltage wiring installed by the Mechanical Contractor, Electrical Contractor or Controls Vendor shall be run in a neat and workmen like manner, parallel and perpendicular to building lines on J-Hooks (above ceiling grid only). Plenum rated cable shall be installed above ceilings. All other locations (exposed, Mechanical Rooms, outdoors or above hard lid ceiling) should be installed in conduit.

2.7 SLEEVES, INSERTS, AND FASTENINGS

A. General: Proper openings through floors, walls, roofs, etc. for the passage of piping, ductwork, conduits, etc. shall be provided. All piping and conduit through floors and piping through walls must pass through sleeves except soil pipe installed under concrete slabs-on-fill, and pipe and conduit that is cast-in-place. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Owner=s Representative.

B. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
   3. 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.

C. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron “wall pipes” for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve 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.

D. Sleeves: The minimum clearance between horizontal pipe, including insulation where applicable, and sleeve shall be 1/4 inch, except that the minimum clearance shall be 2 inches where piping contacts the ground. Sleeves through floors shall extend 3/4 inch above the floor; sleeves through walls and partitions shall be installed flush with exposed surfaces.

E. Materials: Install sleeves large enough to provide ¼” 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.
   2. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS 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.
      a) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.

F. Inserts: Suitable concrete inserts for pipe, conduit, and equipment hangers shall be set and properly located for all piping, conduit, and equipment to be suspended from concrete construction.

G. Fasteners: Fastening of pipes, conduits, etc. in the building shall be as follows:
   1. To wood members: by wood screws.
   2. To masonry and concrete: by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry or concrete.
   3. To steel: machine screws or welding (when specifically permitted or directed), or bolts.
      NOTE: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

H. Ratproofing: The open space around all piping, ductwork, etc. passing through the ground floor and/or exterior walls shall be ratproofed in a manner acceptable to the Owner=s Representative.

I. Weatherproofing: The annular space between a pipe and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50% greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of wall or floor with a fire-resistant sealant.

J. Air Plenums: The space around piping, ductwork, etc. passing through an air plenum shall be made airtight in a manner acceptable to the Owner=s Representative. The sealant used must be fire resistant.

2.8 FIRE AND SMOKE PARTITION, WALL, AND/OR FLOOR PENETRATIONS

A. Pipe, ductwork, conduit, etc. shall pass through fire- or smoke-rated floors, partitions, walls, or other barriers within a UL-listed assembly which shall maintain the rating of the applicable wall, floor, partition, or barrier.

B. The Contractor shall review the architectural and structural drawings and determine the location of the fire-rated building elements. Where these elements are penetrated, UL-listed fire-rated penetration assemblies approved by the local authority shall be provided in accordance with the manufacturer=s instructions to obtain the required rating.

2.9 METAL BUILDING SYSTEMS/MECHANICAL-ELECTRICAL SUPPORTS

A. Metal building systems are required to be designed by the manufacturer to accommodate and support the mechanical systems indicated on the mechanical drawings and specified in Mechanical specifications.

B. The metal building systems manufacturer is required to provide the following:
   1. Framed openings through the roofs with supports, roof curbs, and flashings for roof-mounted equipment, fans, vents, and air intakes.
   2. Structural support for piping, conduits, and suspended equipment consisting of beam, joists, purlins, and/or blocking above and perpendicular to pipe routes and equipment hangers at intervals not to exceed 8 feet.
   3. Structural support for suspended ceilings, diffusers, grilles, light fixtures including associated raceways and ductwork.

C. The mechanical trade shall:
   1. Provide all routes, weights, installation heights, opening locations, etc. for all equipment, piping, vents, etc. to the metal building system manufacturer and coordinate requirements for structural supports, hangers, attachments, etc. with the metal building systems manufacturer.
   2. Provide all supporting devices (hangers, attachments, brackets, cross beams, etc.) to attach to the metal building structural system.

2.10 FOUNDATIONS / HOUSEKEEPING PADS

A. General: All special foundations and supports required for the proper installation of equipment and pipe shall be provided as hereinafter specified and under the section of the specifications covering the equipment, unless otherwise indicated on the drawings.

B. All mechanical equipment shall receive concrete housekeeping pads unless otherwise noted. Equipment to receive pads are to include (but not limited to): air handlers, fan-coils, condensing units, boilers, water heaters, water softeners, expansion / compression tanks, filter feeders, water treatment equipment, air compressors, fans, pumps (in addition to inertia bases where required), chillers, surge tanks, deareators, etc.

C. Concrete foundations for the support of equipment such as floor-mounted pumps, fans, etc. shall be not less than 52 inches high and not less than 4 inches larger (in both directions) than supported unit, unless otherwise noted and shall be poured in forms built of new dressed lumber. All corners of the foundations shall be neatly chamferred by means of sheet metal or triangular wood strips nailed to the form. Pads shall not be laid out directly against walls or structures. 2 inches shall be left available for pad form work. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Allow 1 inch below the equipment bases for alignment and grouting (where applicable). Foundations for equipment located on the exterior of the building shall be provided as indicated. Foundations shall be constructed in accordance with approved shop drawings and shall be reinforced with #4 bars at 12 inches on center both ways (minimum).

D. Pipe and Conduit Support: All pipes and conduits throughout the building, both horizontal and vertical, shall be adequately supported from the construction to line of grade, with proper provision for expansion, contraction, vibration elimination, and anchorage. Vertical pipes and conduits shall be supported from floor lines with riser clamps sized to fit the lines and to adequately support their weight. At the bases of lines, where required for proper support, provide anchor base fittings or other approved supports.

2.11 ACCESS DOORS

A. General: Provide access doors for all serviceable mechanical appurtenances (valves, trap primers, shock arresters, volume dampers, fire/smoke dampers, actuators, sensors, etcetera) in inaccessible locations. Such locations include gypsum, brick and CMU ceilings and walls.

B. Location of panels shall be carefully coordinated with other Exposed Devices as described in earlier paragraphs.

C. Manufacturers shall be Inland-Milcor, Bilco, Miami Carey, or approved equal. Unless indicated otherwise, use panels equal to Milcor Style M for masonry and drywall construction, equal to Milcor Style K for plastered masonry walls and ceilings. Stainless steel panels shall be used in ceramic tile or glazed structural tile.

D. Minimum construction features include 14-gage frame and door, continuous hinges, cam-style latch and 10x10" unobstructed opening size.

E. UL labeled when in fire-rated construction, one and one-half hour rating.

F. Access doors located outside, in restrooms or in a moisture-laden environment (dressing area, shower area, lockers, etc.) shall be stainless steel construction.

G. Equipment access doors shall be of sufficient size to remove/replace equipment and provide routine maintenance as necessary, unless otherwise noted. Doors shall be set flush with adjacent finish surfaces. Exterior doors shall be provided with cylinder locks.

H. Access doors into ductwork shall be 14-gauge insulated galvanized steel with 16-gauge galvanized gasketed steel frame and cam-type locks. Ductwork access door shall be a minimum of 12" $\times$12" in size.

2.12 FLOOR AND CEILING PLATES

A. Except as otherwise noted, provide one-piece chrome-plated brass floor and ceiling plates (or escutcheons) around all pipes, conduits, etc. passing through walls, floors, or ceilings in any spaces, except underfloor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the outside of insulation on lines which are insulated, and

positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend : of an inch above finish floor and are concealed. Plates shall be one piece.

PART 3 - EXECUTION

3.1 SPACE AND EQUIPMENT ARRANGEMENT

A. The size of mechanical equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers will be acceptable, it is the responsibility of the Contractor to determine whether the equipment he proposes to furnish will fit in the space. Shop drawings shall be prepared when required by the Owner=s Representative to indicate a suitable arrangement.

B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

3.2 LARGE APPARATUS

A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

3.3 PROTECTION

A. The Contractor shall take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the uncompleted building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

B. The Contractor shall protect existing facilities, the work of others, and the premises from any and all damages that may be made possible by the execution of work.

C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these specifications.

3.4 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

A. Each trade, subcontractor, and/or Contractor must work in harmony with the various trades, subcontractors, and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

B. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the jobsite in a clean and safe condition. At the end of each day=s work, each trade

shall properly store all of its tools, equipment, and materials and shall clean its debris from the job. Upon the completion of the job, each trade shall immediately remove all of its tools, equipment, any surplus materials, and all debris caused by its portion of the work.

3.5 PRECEDENCE OF MATERIALS AND COORINATION OF WORK

A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the several available spaces, and which will ensure complete and satisfactory systems. Each subcontractor and/or trade shall be responsible for the proper fitting of his material and apparatus into the building.

B. The work of the various trades shall be performed in the most direct and workmanlike manner without hindering or handicapping the work of other trades. Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade for proper operation. Where space requirements conflict, the following order or precedence shall, in general, be observed:
   1. Building lines.
   2. Structural members.
   3. Light fixtures.
   4. Soil and drain piping.
   5. Condensate drains.
   6. Vent piping.
   7. Supply, return, and outside air ductwork.
   8. Exhaust ductwork.
   9. HVAC water and steam piping.
   10. Steam condensate piping.
   11. Fire protection piping.
   12. Natural gas piping.
   13. Domestic water (cold and hot).
   14. Refrigerant piping.
   15. Electrical conduit.

C. The light fixture grid layout as indicated on the drawings must be maintained. This Contractor shall refer to all light fixture plans and details indicated on the drawings and shall coordinate the location of dampers, supply grilles, return air grilles, sprinkler heads, etc. with the location of the light fixtures to assure proper access to all items in a manner acceptable to the Owner’s Representative.

D. The electrical trades shall locate all junction boxes, pull boxes, conduits, etc. to avoid interference with the diffusers, dampers, grilles, etc. hereinbefore mentioned. The mechanical trades shall furnish to all other trades copies of approved ductwork shop drawings to assist in the coordination of the rough-in and installation of all items of work.

3.6 CONNECTIONS FOR OTHERS

A. This Contractor shall rough-in for and make all water, sewer, electrical, etc. connections to all fixtures, equipment, machinery, etc. provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.

B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, connectors, etc.

C. Provide all air gap fittings required, using materials hereinbefore specified. In each water line serving an item of equipment or piece of machinery, provide a shutoff valve. On each drain without integral trap provide a suitable trap.

D. All pipe fittings, valves, traps, etc. exposed in finished areas and connected to chrome-plated lines provided by others shall be chrome-plated to match.

E. Provide all sheet metal ducts, transition pieces, etc. required for a complete installation of equipment provided by others.

3.7 INSTALLATION METHODS

A. Where to Conceal: All pipes and conduits shall be concealed in pipe chases, walls, furred spaces, below suspended floors, or above the ceilings of the building unless otherwise indicated.

B. Where to Expose: In mechanical rooms, janitor's closets tight against pan soffits in exposed Tee structures, or storage spaces, but only where necessary, piping and conduit may be run exposed. All exposed piping and conduit shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.

C. Support: All piping and conduit shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.

D. Maintaining Clearance: Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, rather than hung below them, in a manner to provide maximum above-floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Owner=s Representative for each penetration.

E. All pipe, conduits, etc. shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes, and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that they shall be sloped to obtain the proper pitch. Piping and ducts run in furred ceilings, etc. shall be similarly installed, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.

F. Special Requirements:
1. There shall be no pipe joints nearer than 12 inches to a wall, ceiling, or floor penetration unless pipe joint is a welded or mechanically-coupled-type joint.
2. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Owner=s Representative and resolve the conflict prior to erection of any work in the area involved.
3. All piping not directly buried in the ground shall be considered as Ainterior piping.@
4. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the Owner=s Representative so that arrangements can be made for an inspection of the above-ceiling area about to be Asealed off.@ The Contractor shall give as much advance notice as possible up to ten (10) working days, but in no case less than five (5) working days.
5. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the plumbing systems, and any other special above-ceiling systems such as pneumatic tube. The ceiling supports (tee bar

or lath) should be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.

6. No ceiling material shall be installed until the deficiencies listed from this inspection have been corrected to the satisfaction of the Owner=s Representative.

3.8 CUTTING AND PATCHING

A. General: Cut and patch walls, floors, etc. resulting from work in existing construction or where made necessary by failure to provide proper openings or recesses in new construction.

B. Methods of Cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Owner=s Representative. Impact-type equipment will not be used except where specifically acceptable to the Owner=s Representative. Openings in concrete for pipes, conduits, outlet boxes, etc. shall be core drilled to exact size. **Determine location of embedded conduit and reinforcing bars prior to cutting.**

C. Restoration: All openings shall be restored to Aas-new@ condition under the appropriate specification section for the materials involved, and shall match remaining surrounding materials and/or finishes.

D. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc. shall be of the proper size and shape, and shall be installed in a manner acceptable to the Owner=s Representative.

E. Plaster: All mechanical work in area containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

F. Weakening: No cutting, boring, or excavating which will weaken the structure shall be undertaken.

3.9 ROOF PENETRATIONS AND FLASHING

A. Pipe and conduit ducts, pitch pockets, curb bases, and flashing compatible with the roofing installation shall be provided for roof penetrations. Provide framing or other support around all openings through roof as required to preserve the structural integrity of the roof system and make the penetration weathertight.

B. Provide 30-inch round or square flashing acceptable to the roofing trades at all roof and deck drain and sleeve flashing locations.

C. Roof curbs for all roofs except standing seam metal roofs shall be provided by the equipment supplier supplying the roof-mounted equipment, etc., and such curbs shall be installed by the roofing trades. Contractor shall coordinate all roof curb requirements with all trades and the roofing trades at the earliest possible stage of the project.

D. Roof curbs for standing seam metal roofs shall be provided by the roofing trades. Curb base size, height, and type shall be coordinated with the roofing trades at the earliest possible stage of the project.

E. Flashing for pipe and conduit penetrations of standing seam metal roofs shall be provided and installed by the roofing trades.

3.10 EXCAVATING AND BACKFILLING

A. Perform trenching, excavating, backfilling for mechanical work as set forth below.

B. Depth of excavation to provide a minimum of 3 feet above top of pipe. Excavation to be carried to a depth of at least 6 inches below bottom of pipe elevation. Fill below pipe (6 inches), around pipe, and a minimum of 12 inches above pipe with sand of Class AB@ crushed stone tamped firm and even. Separate topsoil during excavation. Final layer of dirt (12 inches minimum) to be topsoil. Trenches to be at least 18 inches wider than pipe with batter boards placed every 25 feet. Backfilling shall be done to exclude use of rock or stone above sand or Class AB@ crushed stone.

3.11 TESTS AND INSPECTIONS

A. General: The Contractor shall make all tests deemed necessary by the inspection departments of the authority having jurisdiction, Board of Underwriters, etc. He shall provide all equipment, materials, and labor for making such tests. Fuel and electrical energy for system operational tests following beneficial occupancy by the Owner will be paid for by the Owner.

B. Other: Additional tests specified hereinafter under the various specification sections shall be made.

C. Notification: The Owner=s Representative shall be notified at his office 36 hours prior to each test and other specifications requirements requiring action on the part of the Owner, Architect, Engineer, and/or Owner=s Representative.

D. Test Logs: All tests which the Contractor conducts shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description and extent of system tested, test conditions, test results, specified results, and any other pertinent data. Data shall be delivered to the Owner=s Representative as specified under ARequirements for Final Acceptance.

E. Inspections: In general, an inspection by the Owner=s Representative shall be required prior to closing up any work and prior to beneficial occupancy or final project completion. The closing up of work includes, but is not limited to, pipe and conduit installations prior to backfilling; mechanical, electrical, and fire protection work prior to placement of concrete; or closing up walls and overhead mechanical, electrical, and fire protection work prior to installation of the ceiling.

3.12 CLEANING AND PAINTING

A. Thoroughly clean and touch up the finish on all parts of the materials and equipment. Exposed parts in equipment rooms, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out.

B. Exposed metal work which is not galvanized shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean and then painted with a suitable rust resistant primer. Exposed metal work includes work exterior to the building; exposed in mechanical or electrical equipment rooms and storage rooms; and other areas where occupants could see the work, whether normally occupied or not.

C. All other painting shall be accomplished under the Painting Section of Division 9 of the specifications.

3.13 DISCHARGE OF WASTES FROM CONSTRUCTION SITE

A. The Contractor shall comply with all applicable provisions of local, state, and federal laws regarding the discharge of wastes into sewer and waterways. Special caution shall be exercised to prevent the discharge of wastes which contain oil, tar, asphalt, roofing compound, kerosene, gasoline, paint, mud, cement, lime, or other materials which would degrade the water quality of the receiving water course. The Contractor shall construct and maintain oil interceptors, settling basins, acid neutralization tanks, and/or other effective pollution countermeasures, as required by the Texas Water Quality Board.

END OF SECTION

SECTION 23 05 13

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following basic mechanical materials and methods to complement other Mechanical Sections.
   1. Piping materials and installation instructions common to most piping systems.
   2. Concrete base construction requirements.
   3. Escutcheons.
   4. Dielectric fittings.
   5. Dielectric isolation tape
   6. Flexible connectors.
   7. Mechanical sleeve seals.
   8. Nonshrink grout for equipment installations.
   9. Field-fabricated metal and wood equipment supports.
   10. Installation requirements common to equipment specification sections.
   11. Mechanical demolition.
   12. Cutting and patching.
   13. Touchup painting and finishing.
   14. Access Doors

B. Pipe and pipe fitting materials are specified in mechanical piping system Sections, if applicable.

1.2 DEFINITIONS

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

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

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

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

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. NP: Nylon plastic.
   4. PE: Polyethylene plastic.
   5. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. CR: Chlorosulfonated polyethylene synthetic rubber.
2. EPDM: Ethylene propylene diene terpolymer rubber.

1.3 SUBMITTALS

A. Product Data: For dielectric fittings, flexible connectors, access doors, solder/brazing material and mechanical sleeve seals.

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

C. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
1. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
2. Equipment and accessory service connections and support details.
3. Fire-rated wall and floor penetrations.
4. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
5. Access panel and door locations

1.4 QUALITY ASSURANCE

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

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

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

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

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate Mechanical equipment installation with other building components.

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

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

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

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

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dielectric Tape:
      a. Holdrite (#272-4).
   2. Metal, Flexible Connectors:
      a. Flexicraft Industries.
      b. Flex-Hose, Co., Inc.
      c. Grinnell Corp.; Grinnell Supply Sales Co.
      d. Mercer Rubber Co.
      e. Metraflex Co.
      f. Uniflex, Inc.
   3. Rubber, Flexible Connectors:
      a. General Rubber Corp.
      b. Mercer Rubber Co.
      c. Metraflex Co.
      d. Red Valve Co., Inc.
      e. Uniflex, Inc.
   4. Mechanical Sleeve Seals:
      a. Calpico, Inc.
      b. Metraflex Co.
      c. Thunderline/Link-Seal.

2.2 PIPE AND PIPE FITTINGS

A. Refer to individual Specification piping Sections for pipe and fitting materials and joining methods, if applicable.

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

2.3 JOINING MATERIALS

A. Refer to individual Specification piping Sections for special joining materials not listed below, if applicable.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

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

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32.
   1. ASTM B 32, 95/5 lead-free alloys. Include water –flushable and soluble flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8.
   1. BCuP Series: Copper-phosphorus alloys.
   2. BAg1: Silver alloy.

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

H. Solvent Cements: Manufacturer's standard solvent cements for the following:
   1. CPVC Piping: ASTM F 493.
   2. PVC Piping: ASTM D 2564, medium bodied (bond). Include purple primer according to ASTM F 656.

I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.

J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.

K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
   1. Sleeve: ASTM A 126, Class B, gray iron.
   2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
   3. Gaskets: Rubber.
   4. Bolts and Nuts: AWWA C111.
   5. Finish: Enamel paint.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature, to prevent galvanic action and stop corrosion. Unions in first paragraph below are available in at least NPS 1/2 to NPS 2.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Company.
      b. Central Plastics Company.

c. EPCO Sales, Inc.
d. Hart Industries International, Inc.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
f. Zurn Mechanical Products Group; Wilkins Water Control Products.

2. Description:
a. Pressure Rating: 250 psig at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous.
c. Flanges in first paragraph below are available in at least NPS 1-1/2 to NPS 4.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. EPCO Sales, Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
a. Factory-fabricated, bolted, companion-flange assembly.
b. Pressure Rating: 175 psig minimum.
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Advance Products & Systems, Inc.
b. Calico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
2. Description:
a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Calpico, Inc.
b. Lochinvar Corporation.
2. Description:
a. Galvanized-steel coupling.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Female threaded.
d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Mechanical Products, Inc.
c. Victaulic Company.
2. Description:
a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig at 225 deg F.

c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

2.5 DIELECTRIC ISOLATION TAPE

A. Tape to eliminate dissimilar metal contact: (equal to Holdrite #272-4)
1. White Polyester Felt. Pressure sensitive adhesive rubber base (one side only).
2. 4” width.

2.6 FLEXIBLE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
1. 2-Inch NPS and Smaller: Threaded.
2. 2-1/2-Inch NPS and Larger: Flanged.
3. Option for 2-1/2-Inch NPS and Larger: Grooved for use with keyed couplings.

B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

C. Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 125-psig minimum working-pressure rating at 220 deg F. Units may be straight or elbow type, unless otherwise indicated.

2.7 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe materials and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.8 PIPING SPECIALTIES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
a. Underdeck Clamp: Clamping ring with set screws.
5. Sleeve Fasteners: Manufactured, steel clips for securement during pour. Equal to B-line, BD40, BE-5-8 or BE-9-12.

B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
2. OD: Completely cover opening.
3. Cast Brass: One piece, with set screw. (split face acceptable for existing piping)

a. Finish: Polished chrome-plate.

2.9 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
   1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psig, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.10 ACCESS DOORS

A. General: Provide access doors for all serviceable mechanical appurtenances (valves, trap primers, shock arresters, actuators, sensors, etcetera) in inaccessible locations. Such locations include gypsum, brick and CMU ceilings and walls.

B. Location of panels shall be carefully coordinated with other Exposed Devices as described in earlier paragraphs.

C. Manufacturers shall be Milcor, Mifab, or approved equal. Unless indicated otherwise, use panels equal to Milcor Style M for masonry and drywall construction, equal to Milcor Style K for plastered masonry walls and ceilings. Stainless steel panels shall be used in ceramic tile or glazed structural tile.

D. Minimum construction features include 16-gage frame and door, continuous hinges, cam-style latch and 10x10" unobstructed opening size.

E. UL labeled when in fire-rated construction, one and one-half hour rating.

F. Access doors located outside, in restrooms or in a moisture-laden environment (dressing area, shower area, lockers, etcetera) shall be stainless steel construction.

G. Equipment access doors shall be of sufficient size to remove/replace equipment and provide routine maintenance as necessary, unless otherwise noted. Doors shall be set flush with adjacent finish surfaces. All access doors shall be provided with cylinder locks. All access doors (MEP) shall have one (1) common key.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS AND APPLICATIONS

A. General: Install piping as described below, unless piping Sections specify otherwise. Individual piping Sections specify unique piping installation requirements.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

C. All piping to be installed in compliance with current NEC required clearances.

D. Install manufactured isolation clamps at all dissimilar metal pipe supports. Install dielectric isolation tape (engineer approved) only when a manufactured isolation clamp is not available.

E. Install piping at indicated slope.

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

G. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

H. Install piping free of sags and bends.

I. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

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

K. Install piping to allow application of insulation plus 1-inch clearance around insulation.

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

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

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

O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Section "Penetration Firestopping" for firestop materials and installations.
   1. Fire-stop all sleeves at floor penetrations of multistory buildings including underfloor penetrations.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

R. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
   1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
   2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
   3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
   4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   5. 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:
      a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
      b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
      c. Align threads at point of assembly.
      d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
      e. 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.

6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
    a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
    b. CPVC Piping: ASTM D 2846 and ASTM F 493.
    c. PVC Pressure Piping: ASTM D 2672.
    d. PVC Nonpressure Piping: ASTM D 2855.
9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
    a. Plain-End Pipe and Fittings: Use butt fusion.
    b. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.2 ESCUTCHEON REQUIREMENTS

A. Install escutcheons at pipe penetrations of walls, ceilings, and floors in finished areas.
1. Escutcheons for New Piping:
    a. Piping exposed through floors and walls in finished areas: One piece, cast brass with polished chrome-plated finish with set screw. Deep escutcheons to be provided where standard depth will not fit.
    b. Escutcheons shall cover entire hole penetration.
    c. Escutcheon to be appropriately sized for pipe.
2. Escutcheons for Existing piping:
    a. Piping exposed through floors and walls in finished areas: Split plate, cast brass with polished chrome-plated finish with set screw. Deep escutcheons to be provided where standard depth will not fit.
    b. Escutcheons shall cover entire hole penetration.
    c. Escutcheon to be appropriately sized for pipe.
3. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.3 PIPE SLEEVE INSTALLATION REQUIREMENTS

A. Pipe sleeves are required at all through wall and floor penetrations.
1. Sleeves are to be of the following material:
    a. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
2. Sleeves are required for all through floor and wall penetrations. Sleeves to be set and poured in place (in slab applications), secure all sleeves with fasteners.
3. Sleeves to extend 2 inches past face of floor or wall. Pipe sleeve in finished areas to be flush with wall or floor for installation of escutcheon.
4. Install sleeves in new partitions, slabs, and walls as they are built.
5. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Section "Joint Sealants" for joint sealants.

6. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Section "Joint Sealants" for joint sealants.
7. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
8. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated. Seal annular space with water tight sealant. (equal to NP-1). All sleeves and penetrations to maintain rating of wall / floor. Seal pipe penetrations with fire-stopping materials.
9. Install sleeve materials according to the following applications:
    a. Sleeves for Piping Passing through Concrete Floor Slabs: galvanized steel pipe.
    b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe sleeves.
        1) Extend sleeves 2 inches above finished floor level.
        2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements in Section "Sheet Metal Flashing and Trim" for flashing.
10. Sleeves for Piping Passing through Gypsum-Board Partitions:
    a. Galvanized-steel pipe sleeves.
    b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual mechanical fixtures if escutcheons will cover openings.
11. Sleeves for Piping Passing through Concrete Roof Slabs: Reference details.
12. Sleeves for Piping Passing through Exterior Concrete Walls:
    a. Galvanized-steel pipe sleeves.
    b. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
13. Sleeves for Piping Passing through Interior Concrete Walls:
    a. Galvanized-steel pipe sleeves.
14. Mechanical sleeve seals
    a. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building. Sleeves must be poured in place. Installation of sleeves after wall is constructed is not acceptable.
    b. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

B. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
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.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.

B. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.

3.5 EQUIPMENT INSTALLATION – COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment giving right of way to piping installed at required slope.

3.6 PAINTING AND FINISHING

A. Apply paint to exposed piping according to the following, unless otherwise indicated:
   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 Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.

B. Do not paint piping specialties with factory-applied finish.

C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 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."

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment (not to be used at pipe supports).

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 DEMOLITION

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.10 CUTTING AND PATCHING

A. Disconnect, demolish, and remove Work specified in Mechanical Sections.

B. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

D. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

E. Removal: Remove indicated equipment from Project site.

F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.11 GROUTING

A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 19

METERS AND GAUGES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following meters and gauges for mechanical systems:
   1. Thermometers.
   2. Gauges.
   3. Test plugs.

B. Related Sections include the following:
   1. Specification Section "Hydronic Piping" for water appurtenances.

1.2 SUBMITTALS

A. Product Data: For each type of product to be installed.

B. Operation and Maintenance Data: For all products to be installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:
   1. Palmer - Wahl Instruments Inc.
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.
   4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Black-finished, Aluminum, 9 inches long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently baked on scale markings on lens (U.V. protected).

E. Window: Glass.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Brass for thermowell installation and of length to suit installation.

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

2.3 THERMOWELLS

A. Manufacturers:
   1. Palmer – Wahl Instruments Inc.
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.
   4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Provide extended neck to accommodate insulation thickness.

2.4 PRESSURE GAUGES

A. Manufacturers:
   1. Palmer – Wahl Instruments Inc.
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.
   4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct Mounting, Dial-type Dry or Liquid Filled Pressure Gauges: Indicating-dial type complying with ASME B40.100.
   1. Case: Dry or Liquid-filled type, stainless steel, 4-inch diameter. Weatherproof.
   2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
   3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
   4. Movement: Mechanical, with link to pressure element and connection to pointer.
   5. Dial: Satin-faced, nonreflective aluminum with baked on scale markings.
   6. Pointer: Red or other dark-color metal.
   7. Window: Glass
   8. Ring: Stainless
   9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
   10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
   11. Range of Fluids under Pressure: Two times operating pressure.

C. Pressure-Gauge Fittings:
   1. Valves: NPS ¼ brass or stainless-steel needle type.
   2. Syphons: NPS ¼ coil of brass tubing with threaded ends.
   3. Snubbers: ASME B40.5,NPS ¼ brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS (PT PORTS)

A. Manufacturers:
   1. Palmer – Wahl Instruments, Inc.
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.
   4. Weksler Instruments Operating Unit: Dresser Industries; Instrument Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F

D. Core Inserts: One or two self-sealing rubber valves.
   1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
   2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

2.6 TEMPERATURE AND PRESSURE

A. Test Kit: Furnish (1) test kit containing one pressure gauge and adaptor, two (2) thermometers, and carrying case. Pressure gauge, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
   1. Pressure Gauge: Small bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range shall be 0 to 200 psig.
   2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
   3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
   4. Carrying case shall have formed instrument padding.

2.7 FLOW INDICATORS

A. Manufacturers:
   1. Dwyer Instruments, Inc.
   2. Ernst Gauge Co.

B. Description: Instrument for installation in piping systems for visual verification of flow.

C. Construction: Bronze or stainless-steel body; with sight glass and ABS plastic paddle-wheel indicator, and threaded or flanged ends.

D. Pressure Rating: 125 psig.

E. Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:
   1. Inlet and outlet of each hydronic boiler, chiller and cooling tower.
   2. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems (including fan coils)
   3. Inlet and outlet of each hydronic heat exchanger.
   4. Inlet and outlet of each hydronic heat-recovery unit.
   5. Inlet and outlet of each thermal storage tank.
   6. Outlet of all domestic water heaters.
   7. On hot water return line after pump (Domestic)
   8. At the following locations for mixing valves:

3.2 PRESSURE GAUGE APPLICATIONS

A. Install dry-case-type pressure gauges for discharge of each pressure-reducing valve inlet and outlet of all backflow preventers (Domestic water).

B. Install liquid-filled-case-type pressure gauges at chilled- and condenser-water inlets and outlets of chillers and cooling towers.

C. Install liquid-filled-case-type pressure gauges at suction and discharge of each pump, pressure reducing valve (hydronic), inlet and outlet of all backflow preventers (hydronic).

D. Install liquid filled-case-type pressure gauges at hot water inlets and outlets of boilers (hydronic).

3.3 FLOW INDICATOR APPLICATION

A. Install wheel type indicator on outlet side of filter feeder.

3.4 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

C. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

D. Install ¼" NPT, ¼ turn ball-valve and snubber fitting in piping for each pressure gauge for fluids.

E. Install test plugs in tees in piping.

F. Install flow indicators, in accessible positions for easy viewing, in piping systems.

G. Install test ports (PT plugs) where indicated on drawings/details and adjacent to all DDC temperature and pressure sensing devices for device calibration/verification. PT plugs shall have minimum 6-inch clear access and the mounting angle shall be vertical.

3.5 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance for meters, gauges, machines, and equipment.

3.6 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and Gauges to proper angle for best visibility.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for mechanical system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Equipment supports.

B. Related Sections include the following:
   1. Specification Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Specification Section “Metal Ducts” for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.

3. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL COATING REQUIREMENTS:

A. All metal products shall have the following coatings:
1. Wet/damp areas: hot dipped galvanized.
2. Dry or conditioned areas: pre-galvanized.

2.3 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pre-galvanized (minimum thickness of 0.5 mils) or hot dipped (1.4 to 3.9 mil thickness).

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.4 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.5 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert with a sheet metal shield.

B. Manufacturers:
1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Buckaroos

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier. **Wood inserts are not acceptable.**

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. Insulation-Insert Material for Hot Piping only, up to 3” diameter: Molded fiberglass block, 20 lbs/ft^3 density, thermal conductivity of 0.30.

F. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

G. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

H. Insert Length: Extend 4 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers:
      a. B-Line Systems, Inc.; a division of Cooper Industries.
      b. Empire Industries, Inc.
      c. Hilti, Inc.
      d. ITW Ramset/Red Head.
      e. MKT Fastening, LLC.
      f. Powers Fasteners.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars.
   1. Exterior: Galvanized steel.
   2. Interior: Black steel.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

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

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

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
   6. C-Clamps (MSS Type 23): For structural shapes.
   7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
   8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
   9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
   10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
   11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
   12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
       a. Light (MSS Type 31): 750 lb.
       b. Medium (MSS Type 32): 1500 lb.
       c. Heavy (MSS Type 33): 3000 lb.
   13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
   14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
   15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Thermal-Hanger Shield Inserts: For supporting insulated cold pipe. **Wood inserts are not acceptable.**

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
   2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
   4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
   5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

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

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments in concrete construction only in locations approved by the structural engineer.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure; **attaching to metal roof decks is not permissible.**

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

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

G. Equipment Support Installation: Install suspended units on supports fabricated from welded-structural-steel shapes or from strut channels as applicable for the unit weight. Vertical

support members must be appropriately sized threaded rods. Metal straps or cables are not allowed. Isolate units to prevent vibration or noise as specified in other sections.

H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads for NPS 2-1/2 and larger, including valves, flanges, and strainers, and at changes in direction of piping (24" maximum distance from elbow). Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

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

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install thermal-hanger shield inserts on insulated piping with vapor barrier. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   5. Insert Material: Length at least as long as protective shield.
   6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

N. Insulated Ducts (Mineral Fiber Blanket). Comply with the following:
   1. At all unistrut supports provide mineral fiber board insert in between ductwork and unistrut. Insert to extend 12" on both sides of unistrut, full length of strut. Extend blanket between structural insert.

3.3 EQUIPMENT SUPPORTS

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

B. Grouting: Place grout under supports for floor-mounted equipment to make a smooth bearing surface.

C. Provide lateral bracing to prevent swaying for suspended equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

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

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

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

B. Trim excess length of continuous-thread hanger support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, field cuts, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:
   1. Equipment nameplates.
   2. Equipment markers.
   3. Equipment signs.
   4. Access panel and door markers.
   5. Pipe markers.
   6. Duct markers.
   7. Stencils.
   8. Valve tags.
   9. Valve schedules.
   10. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals. Reproduce on 8½ 11 bond. Tabulate valve number, piping system, system abbreviation as shown on tag, room or space location of valve, and variations for identification. Mark valves intended for emergency shutoff and similar special uses. Indicate normal operating positions (open, closed, modulating, or balance).

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 GENERAL

A. Products specified are for applications referenced in other Mechanical sections. In addition to a factory installed equivalent nameplate, all equipment shall have an engraved equipment sign that matches the schedule tag name.

2.2 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
   1. Data:
      a. Manufacturer, product name, model number, and serial number.
      b. Capacity, operating and power characteristics, and essential data.
      c. Labels of tested compliances.
   2. Location: Accessible and visible.
   3. Fasteners: As required to mount on equipment.
   4. Material: Brass.

B. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
   1. Data: Instructions for operation of equipment and for safety procedures.
   2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
   3. Thickness: 1/8 inch, unless otherwise indicated.
   4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.3 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Manufacturers standard preprinted, semi-rigid, snap-on type.
   1. Colors: Comply with ASME A13.1, unless otherwise indicated.
   2. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
   3. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
   4. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
   5. Lettering: Manufacturers standard preprinted.

2.4 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive. See Execution section for color scheme.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Provide 5/32-inch hole for fastener.
   1. Material: 0.032-inch thick aluminum.
   2. Valve-Tag Fasteners: Brass S-hook.
   3. Size: 1½ inches in diameter, unless otherwise indicated.

2.6 VALVE SCHEDULES

A. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.

B. Frame: Extruded aluminum.

C. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
   1. Size: 3 by 5-1/4 inches **minimum**.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
   4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Mechanical Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
   1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
   2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
   3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
   4. Fans, blowers, primary balancing dampers, and mixing boxes.
   5. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent fasteners on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
   1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, ½ inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
   3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
      a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

b. Fire department hose valves and hose stations.
c. Meters, gages, thermometers, and similar units.
d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
g. Fans, blowers, primary balancing dampers, and mixing boxes.
h. Packaged HVAC central-station and zone-type units.
i. Tanks and pressure vessels.
j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
a. Green: For cooling equipment and components.
b. Yellow: For heating equipment and components.
c. Green and Yellow, Orange: For combination cooling and heating equipment and components.
d. Brown: For energy-reclamation equipment and components.
2. Letter Size: Minimum 1/2 inch for name of units if viewing distance is less than 24 inches, 3/4 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. Include signs for the following general categories of equipment:
a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
e. Fans, blowers, primary balancing dampers, and mixing boxes.
f. Packaged HVAC central-station and zone-type units.
g. Tanks and pressure vessels.
h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches: Snap-on application of pretensioned, semi-rigid plastic pipe marker.
2. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with manufacturer's stainless steel bands.
3. Fasten Option: Laminated or bonded application of pipe marker to pipe or insulation.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; in machine rooms; in accessible maintenance spaces such as shafts, tunnels and plenums; and in exterior nonconcealed locations such as rooftops and chiller yards, as follows:
1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings.

3.4 DUCT IDENTIFICATION

A. Install duct markers with permanent adhesive on air ducts in the following color codes:
   1. Green: For cold-air supply ducts.
   2. Yellow: For hot-air supply ducts.
   3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
   4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
   5. Letter Size: Minimum 1/2 inch for name of units if viewing distance is less than 24 inches, 3/4 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system. Reduce intervals to 25 feet in areas of high duct congestion.

3.5 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 VALVE TAGS

A. Install on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.

B. Valve Tag Application Schedule: Tag valves according to size, shape, color scheme, and with captions similar to those indicated in the following:

C. Tag Material: Aluminum.

D. Tag Size and Shape: 1-1/2 inches, round.

E. Tag Color: According to the following:
   1. Chilled Water: Blue.
   2. Cold Water: Black.
   3. Hot Water: Red.
   4. Fire Protection: Red.
   5. Sprinkler: White.

6. Gas: Yellow.
7. Steam: Red.

F. Letter Color: White.

G. Install mounted valve schedule in each major equipment room.

3.8 EQUIPMENT SIGNS AND MARKERS

A. Install engraved plastic-laminate signs or equipment markers on or near each major item of mechanical equipment. Include signs for the following general categories of equipment:
1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gages, thermometers, and similar units.
3. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
4. Pumps, compressors, chillers, condensers, and similar motor-driven units.
5. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
6. Fans, blowers, primary balancing dampers, and mixing boxes.
7. Packaged HVAC central-station and zone-type units.
8. Tanks and pressure vessels.
9. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
10. Any concealed appurtenances requiring access for maintenance shall be clearly identified by sign (to include but not be limited to unions, strainers, valves, etc.).

B. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows showing service and direction of flow.
1. Location: Locate signs near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.9 ADJUSTING AND CLEANING

A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.

B. Clean faces of identification devices and glass frames of valve charts.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The work included in this section consists of the furnishing of all labor, instruments, tools, and services required in connection with the testing, adjusting and balancing (TAB) of the heating, ventilating, and air conditioning systems as described in the mechanical specifications and/or shown on the mechanical plans, or reasonable implied therefrom.

B. TAB of the HVAC systems will be performed by an impartial technical firm that is a member of NEBB and whose operations are limited to the field of professional testing and balancing.

C. Mechanical Contractor to obtain TAB services from an independent TAB contractor.

D. Qualified TAB firms shall submit cost, scope of work, qualifications, time line, and references.

E. The TAB firm is responsible to and shall submit five (5) copies of all reports directly to the Architect/Engineer and one copy to the Owner.

F. TAB services shall result in the optimum temperature, airflow, and noise levels in the conditioned space of the project.

G. The following basic components of the HVAC systems shall be tested, adjusted, and balanced:
   1. Air distribution systems.
   2. Air moving equipment.
   3. HVAC pumps (chilled water, hot water, condenser water, etc.).
   4. Heating systems (HVAC).
   5. Control systems verification.

1.2 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
   1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
   2. Adjusting total HVAC systems to provide indicated quantities.
   3. Measuring electrical performance of HVAC equipment.
   4. Setting quantitative performance of HVAC equipment.
   5. Verifying that automatic control devices are functioning properly.
   6. Measuring sound and vibration.
   7. Reporting results of the activities and procedures specified in this Section.

B. Related sections include the following:
   1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment. See all related HVAC mechanical sections.
   2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

M. NEBB: National Environmental Balancing Bureau.

N. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

B. Contract Documents Examination Report: Within 45 days from the Contractor’s Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.

C. Strategies and Procedures Plan: Within 60 days from the Contractor’s Notice to Proceed, submit 2 copies of the testing, adjusting and balancing strategies and step-by-step procedures as specified in Part 3 “Preparation” Article below. Include a complete set of report forms intended for use on this Project.

D. Certified Testing, Adjusting and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting and balancing Agent.

E. Sample Report Forms: Submit 2 sets of sample testing, adjusting and balancing report forms.

F. Warranty: Submit 2 copies of special warranty specified in the “Guarantee” Article below.

1.5 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by NEBB.

B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.
   1. Agenda Items: Include at least the following:
      a. Submittal distribution requirements.
      b. Contract Documents examination report.
      c. Testing, adjusting, and balancing plan.
      d. Work schedule and Project site access requirements.
      e. Coordination and cooperation of trades and subcontractors.
      f. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
   2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every 12 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 GUARANTEE

A. General: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2- PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
   2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

D. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

F. Examine system and equipment test reports.

G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves

and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

K. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

L. Examine strainers for clean screens and proper perforations.

M. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

P. Examine equipment for installation and for properly operating safety interlocks and controls.

Q. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices operate by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. The Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
   5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
   8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
   9. Interlocked systems are operating.
   10. Changeover from heating to cooling mode occurs according to design values.

R. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.

3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so design conditions for system operations can be met.
9. Motors are wired properly with appropriate overloads and correct rotation.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

3.5 VARIABLE-AIR-VOLUME SYSTEMS' ADDITIONAL PROCEDURES

A. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Balance systems similar to constant-volume air systems.
   2. Set terminal units and supply fan at full-airflow condition.
   3. Adjust inlet dampers of each terminal unit to design airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   4. Readjust fan airflow for final maximum readings.
   5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
   6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
   7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
   8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.6 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check expansion tank liquid level.
   3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at design flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 HYDRONIC SYSTEMS' BALANCING PROCEDURES

A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.

E. Adjust balancing stations to within specified tolerances of design flow rate as follows:
1. Determine the balancing station with the highest percentage over design flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.
3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.8 VARIABLE-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

A. Balance systems with automatic 2- and 3-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

A. Balance the primary system crossover flow first, then balance the secondary system.

3.10 MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating if high-efficiency motor.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.11 BOILERS

A. Measure entering- and leaving-water temperatures and water flow.

3.12 HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:
   1. Entering- and leaving-water temperatures.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperatures of entering and leaving air.
   5. Wet-bulb temperatures of entering and leaving air.
   6. Airflow.
   7. Air pressure drop.

B. Electric-Heating Coils: Measure the following data for each coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperatures at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kW at full load.
   6. Fuse or circuit-breaker rating for overload protection.

3.13 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.14 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.

J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.15 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans: -5 to plus 10 percent.
   2. Air Outlets and Inlets: ± 10 percent.
   3. Heating-Water Flow Rate: ± 10 percent.
   4. Cooling-Water Flow Rate: ± 5 percent.

3.16 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

C. Preliminary Report: Submit preliminary TAB reports to the design engineer for each floor, the central plant, and the chilled and hot water hydronic system.

3.17 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Final Report Contents: In addition to the certified field report data, include the following:
   1. Pump Curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance, but not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of testing, adjusting and balancing Agent.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of testing, adjusting and balancing Agent who certifies the report.
   10. Summary of contents, including the following:
      a. Design versus final performance.
      b. Notable characteristics of systems.

c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:
    a. Settings for outside-return-and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet-and dry-bulb, conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume, systems.
    g. Settings for supply-air, static-pressure, controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Quantities of outside, supply, return and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Locations of duct traverse(s) of duct layout.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches and bore.
    i. Sheave dimension, center-to-center and amount of adjustments in inches (mm).
    j. Number of belts, make and size.
    k. Number of filters, type and size.
2. Motor Data: Include the following:
    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches and bore.
    f. Sheave dimensions, center-to-center and amount of adjustments in inches.
3. Test Data: Include design and actual values for the following:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.

G. Apparatus-Coil Test Reports: For apparatus coils, include the following:
1. Coil Data: Include the following:
    a. System Identification.
    b. Location.
    c. Coil type.

d. Number of rows.
e. Fin spacing in fins per inch.
f. Make and model number.
g. Face area in sq.ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data: Include design and actual values for the following:
a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet and dry-bulb temperatures in deg F.
e. Return-air, wet and dry-bulb temperatures in deg F.
f. Entering-air, wet and dry-bulb temperatures in deg F.
g. Leaving-air, wet and dry bulb temperatures in deg F.
h. Return-air, wet and dry-bulb temperatures in deg F.
i. Entering water temperature in deg F.
j. Leaving water temperature in deg F
k. Water flow rate in gpm.
l. Water pressure differential in feet of head or psig.

H. Water Chiller Test Reports: For chillers (Air Cooled or Water Cooled)
1. Unit Data: Include the following:
a. Unit Identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
2. Motor Data:
a. Make and frame type and size.
b. Volts, phase and hertz.
c. Full-load amperage and service factor.
3. Test Data:
a. Total chilled water flow rate in gpm.
b. Total condenser water flow rate in gpm.
c. WPD in ft across chilled water.
d. WPD in ft across condenser water.
e. Chilled water supply and return temperatures ˚F.
f. Condenser water supply and return temperatures in ˚F.

I. Cooling Tower Test Reports: For condenser water cooling tower:
1. Unit Data: Include the following:
a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
2. Motor Data (Fan or Pump): Include the following:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
3. Test Data: Include design and actual values for the following:
a. Total condenser under flowrate in gpm.

b. Total wpd in ft across condenser water.
c. Condenser water supply and return temperatures in ˚F.
d. Fan rpm.

J. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data: Include the following:
a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btuh (kW).
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft.
j. Minimum face velocity in fpm.
2. Test Data: Include design and actual values for the following:
a. Heat output in Btuh.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

K. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data: Include the following:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
2. Motor Data: Include the following:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center and amount of adjustments in inches.
g. Number of belts, make, and size.
3. Test Data: Include design and actual values for the following:
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

L. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data: Include the following:
a. System and air-handling unit number.
b. Location and zone.
c. Locate traverse location on duct work layout.

d. Traverse air temperature in deg F.
e. Duct static pressure in inches wg.
f. Duct size in inches.
g. Duct area in sq. ft.
h. Design airflow rate in cfm.
i. Design velocity in fpm.
j. Actual airflow rate in cfm.
k. Actual average velocity in fpm.
l. Barometric pressure in psig.

M. Air-Terminal-Device Reports: For terminal units, include the following:
1. Unit Data: Include the following:
a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft.
2. Test Data: Include design and actual values for the following:
a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

N. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data: Include the following:
a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.
2. Test Data: Include design and actual values for the following:
a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

O. Instrument Calibration Reports: For instrument calibration, include the following:
1. Report Data: Include the following:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

END OF SECTION

SECTION 23 07 19

MECHANICAL INSULATION

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes mechanical insulation for duct, equipment, and pipe, including the following:
   1. Insulation Materials:
      a. Cellular glass.
      b. Flexible elastomeric.
      c. Mineral fiber.
      d. Phenolic
   2. Adhesives.
   3. Mastics.
   4. Sealants.
   5. Factory-applied jackets.
   6. Field-applied fabric-reinforcing mesh.
   7. Field-applied tape.
   8. Field-applied jackets.
   9. Securements.
   10. Corner angles.

B. Related Sections include the following:
   1. Specification Section "Metal Ducts" for duct liners.
   2. Specification Section “Hangers and Supports” for high-density inserts at hangers; **wood inserts at hangers are not acceptable.**
   3. Specification Section “Special Conditions for All Mechanical Work”.
   4. Specification Section “Basic Mechanical Materials and Methods”.

C. Not all items listed within this specification are used. Use only items applicable per application schedule.

1.3 DEFINITIONS

A. ASJ: All-service jacket.

B. CONCEALED: Covered or concealed by a ceiling (gypsum or lay-in acoustical tile) or wall.

C. EXPOSED: Open to view; not concealed by a ceiling or wall of any sort.

D. FSK: Foil, scrim, kraft paper.

E. UNDERFLOOR: Accessible crawl space beneath lowest floor level. (considered “outdoors”)

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any). Provide submittal data on all products to be used.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. All products to be stored in a dry location, protected from the elements. All damaged insulation to be replaced.

1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and high-density insulation inserts and shields specified in Specification Section "Hangers and Supports." Coordinate with drawing details where applicable; wood inserts at hangers are not acceptable.

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

C. Insulation not to be installed until building is dried in.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Phenolic:
   1. Manufacturers:
      a. Resolco
      b. Dyplast Products
      c. Polyguard
      d. Approved equal.
   2. 100% CFC-free, HCFC-free, and halogen-free, closed cell rigid phenolic foam insulation.
   3. Minimal thermal conductivity @ 75˚ F
      a. Green, 2.5 lb/ft³: 0.15 (Btu.in/hr.ft². F)
      b. Pink, 5.0 lb/ft³: 0.21 (Btu.in/hr.ft². F)

G. Cellular Glass:
   1. Manufacturers:
      a. Pittsburgh Corning Corporation; Foamglas Super K.
   2. Block Insulation: ASTM C 552, Type I.
   3. Special-Shaped Insulation: ASTM C 552, Type III.
   4. Board Insulation: ASTM C 552, Type IV.
   5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
   6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
   7. Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Minimal thermal conductivity at 75˚ F of 0.27 (Btu.in/hr.ft². F) (R-value of 10.34@ 3 inches thickness). Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.

H. Flexible Elastomeric:
   1. Manufacturers:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacel LLC; AP Armaflex.
   2. Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   3. Minimal thermal conductivity at 75˚ F of 0.25 (Btu.in/hr.ft². F).

I. Mineral-Fiber Blanket Insulation:
   1. Manufacturers:

a. Johns Manville; Microlite.
b. Knauf Insulation; Duct Wrap
c. Owens-Corning; All-Service Duct Wrap.

2. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied jackets” Article.
3. Minimal density of 1.0 lb/ft³, installed R-value of 6.0 (at 2" thick).

J. Mineral-Fiber Board Insulation:
1. Manufacturers:
a. Johns Manville; 800 Series Spin-Glas.
b. Knauf Insulation; Insulation Board.
c. Owens Corning; Fiberglas 700 Series.
2. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
3. Minimal density of 2.25 lb/ft³, with a R-value of 8.7 (at 2" thickness).

K. Mineral-Fiber, Preformed Pipe Insulation:
1. Manufacturers:
a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000° Pipe Insulation.
c. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Minimum thermal conductivity at 75˚ F of 0.23 (Btu.in/hr.ft². F). Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. All products are to contain low V.O.C. as defined/governed by LEED IEQ 4.1 and 4.2 (Regardless of project type).

B. Cellular-Glass, One part, acetoxy cure, silicone adhesive, with a service temperature range of minus 50 to plus 400 deg F.
1. Products:
a. Foamglas: PC RTV 450 Sillicone Adhesive

C. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.
1. Products:
a. K-Flex: 720 LVOC or equal

D. Phenolic: Water based adhesive with a service temp of minus 20°F to 700°F.
1. Products:
a. Foster 97-15

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products:
a. Design Polymerics, DP2502 (or approved equal).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. All products are to contain low V.O.C. as defined/governed by LEED IEQ 4.1 and 4.2 (Regardless of project type).

B. Vapor-Barrier Mastic: Water based; suitable for outdoor use on below ambient services, or indoor vapor barrier use.
   1. Products:
      a. Childers Products, Division of ITW; CP-35.
   2. Water-Vapor Permeance: ASTM F 1249, 0.09 perm at 55-mils film thickness.
   3. Service Temperature Range: Minus 20 to plus 190 deg F.
   4. Solids Content: ASTM D 1644, 60 percent by volume and 73 percent by weight.
   5. Color: White.
   6. VOC: 36 g/l

2.5 SEALANTS

A. Joint Sealants:
   1. Joint Sealants for Cellular-Glass Products:
      a. Pittsburgh Corning Corporation; Pittseal 444N.
   2. Joint Sealant for Phenolic Products
      a. Foster 95-50

B. Metal Jacket:
   1. Products:
      a. Foster 95-44 or equal.
      b. Childers Products, Division of ITW; CP-76.

C. Mineral Fiber:
   1. Design Polymerics DP 2502.
   2. Childers Products, Division of ITW; CP-35.

D. PVC Jacket:
   1. Childers Products, Division of ITW; CP-35.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 2.2 oz./sq. yd. 10 x 10 strand count per square inch, minimum 4" wide band.
   1. Available Products:
      a. Chil-glas #10.
      b. Charles Harmon and Co. white weaveset.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, 25/50 ASTM-F 84, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products:
      a. Johns Manville; Zeston.
      b. Proto PVC Corporation; LoSmoke.
   2. Color: White:
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
   4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:
   1. Products:
      a. Childers Products, Division of ITW; Metal Jacketing Systems.
   2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
      a. Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
   1. Width: 4 inches.
   2. Thickness: 14.0 mils.
   3. Adhesion: 73 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 55 lbf/inch in width.
   6. Color: White

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
   1. Width: 4 inches.
   2. Thickness: 13 mils.
   3. Adhesion: 73 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. Color: Silver

2.10 SECUREMENTS

A. Bands:
   1. Products:
      a. Childers Products; Bands.
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
   3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch with wing or closed seal.
   4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Insulated Weld Pins: Zinc-coated steel pin, fully annealed for capacitor-discharge welding, 12 Gauge shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer. **Contractor to field verify, integrity of pin weld on ductwork with sheet metal thickness less than 22-gauge. Integrity to be verified prior to concealment with insulation.**
   a. Products:
      1) GEMCO; Cupped Head Weld Pin or equal.
2. Metal, “Peel and Press” Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products:
      1) GEMCO; Peel and Press or equal.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 12 Gauge diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Insulation-Retaining Washers and Cap: Self-locking cap washers formed from 12 Gauge, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application. For Stainless Steel; apply a corrosion coating to insulated surfaces with an epoxy primer and an epoxy finish 5 mils thick.

B. Verify and coordinate insulation installation with the systems and trades installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install high-density inserts at hanger locations prior to insulating (duct and pipe); wood or block inserts are not acceptable.

F. Install insulation with longitudinal seams at top and bottom of horizontal runs.

G. Where multiple layers of insulation are required, longitudinal and end seams are to be staggered.

H. Do not weld brackets, clips, pins or other attachment devices to piping, fittings, tanks, coils, equipment, vessel, and specialties.

I. Keep insulation materials clean and dry before, during application, and finishing.

J. Install insulation with tight longitudinal seams and end joints.

K. Install insulation with least number of joints practical.

L. Install insulation so that material is not over compressed. Install corner angles prior to insulating; to protect all insulation from damage.

M. Seal all joints, and seams, including penetrations in insulation, at supports, and other projections with insulation of same material overlapped by 2”. Secure strips with outward clinching staples along edge of overlap, (spaced 1 inch on center) and seal entire joint or seam with mastic and embedded fiberglass reinforcing mesh, minimum 4", cover mesh with finish coat of mastic.

N. Do not insulate, conceal, or enclose pipe hangers, channel and steel supports, etc. not directly fasten to duct.

O. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

P. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses. Do not water down products unless directed by manufacture. Use clean potable demineralized water when required.

Q. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

R. Repair all damage insulation prior to concealment as noted above.

S. Do not insulate or conceal vibration-control devices, labels, stamps, nameplates, data plates, manholes, cleanouts, etc. require for maintenances.

T. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarded integrity, unless otherwise indicated.

U. Insulate pipe elbows, tees, valves, strainers, flanges, etc., using preformed fitting insulation, mitered fittings or oversized preformed pipe insulation made from same material thickness and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, voids, and irregular surfaces with insulating mastic finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation. Provide a removable reusable insulation cover; design that maintains vapor barrier. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts.

V. Cover segmented insulated surfaces with a layer of finishing adhesive and coat with a vapor-barrier mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

W. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Secure PVC covers to adjoining insulation facing using staples and ASJ tape. Seal PVC fitting covers with mastic.

X. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating adhesive and finish with mastic. All connections are to be accessible.

Y. Install removable insulation segment and covers at flanges, valves, controls, unions, equipment access doors, manholes, hand holes, and other elements that require frequent removal for service and inspection. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.4 PENETRATIONS

A. Install insulation continuously through all walls, floors, and partitions penetrations and sleeves.

B. Extend jacket of outdoor installation into wall and roof jacks by 2 inches. Seal jacket to roof flashing with approved flashing sealant.

C. Insulation Installation at Fire-Rated Walls, floors and Partitions Penetrations for duct work where fire/smoke dampers are required: Terminate insulation at fire damper sleeves as require by damper manufacturer. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

3.5 GENERAL PIPE INSULATION INSTALLATION (IN ADDITION TO COMMON REQUIREMENTS)

A. Preformed Pipe Insulation Installation on Pipe, Fittings, Valves, Flanges, Tanks, Elbows, and Appurtenances for Cellular- Glass, Mineral- Fiber, Flexible Elastomeric, and Phenolic insulations:

1. Install insulation in a manner that secures material to system being insulated with staples, tape and mastic.
2. When insulation with preformed pipe insulation, seal all longitudinal seams, end joints, and protrusions with manufacturers recommended tape matching jacket, vapor-barrier mastic, joint sealant, and adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
3. Secure fittings, jacket, cover, etc. with tape matching jacket and secure with outward clinched staples 1 inch on center. Apply vapor-barrier mastic over staples.
4. Arrange insulation to permit access to valves packing, flanges, unions, etc. and valve operation for maintenance without disturbing insulation. Install insulation so that it can be removed without damage to surrounding insulation or access enclosure.
5. Pipe hangers are not to be concealed in insulation.
6. Seal all exposed insulation ends with mastic.
7. Seal all mitered joints prior to installing covers with vapor-barrier sealant and mastic.
8. Install preformed pipe insulation to outer diameter of pipe flange.
9. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
10. Fill voids between inner circumference of valves, flange, elbows, and bolts insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
11. Install preformed sections of same material insulation when available. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Install PVC cover over fitting or mitered section.
12. Arrange insulation to permit access to valves packing, flanges, unions, etc. and valve operation for maintenance without disturbing insulation. Install insulation so that it can be removed without damage to surrounding insulation or access enclosure.

3.6 GENERAL BLANKET AND BOARD INSULATION INSTALLATION (IN ADDITION TO COMMON REQUIREMENTS)

A. Blanket and Board Insulation Installation on Duct, Tanks, Vessels, Elbows, and Appurtenances:
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for a minimum of 50 percent coverage of duct and plenum and 100 percent coverage of equipment, tanks, etc.; to secure insulation to surfaces. Apply adhesive to entire circumference of all surfaces; including fittings and transitions.
   2. Install cupped-head, capacitor-discharge-weld pins surfaces to secure insulation to ductwork. Install on sides and bottom of horizontal and vertical ducts having a width or height greater than 23 inches. Locate 16 inches center and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface as required by manufacturer recommendation. Use approved adhesive stick anchor pins with washers for all equipment, tanks, etc. Cut excess portion of stick anchor pins and install washer’s caps. Cover exposed pins and washers caps with tape and mastic matching insulation facing.
   3. Install PVC corner angles prior to installing blanket insulation.
   4. Do not over compress insulation during installation. Cover exposed pins and washers with tape matching insulation facing and mastic.
   5. Install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 3/4-inch outward-clinching staples, 1 inch on center. Coat all seams/joints with mastic and embed with fiberglass reinforced mesh, minimum 4", cover mesh with finish coat of mastic.

6. Repair punctures, tears, penetrations and protrusions with 6-inch-wide strips of same material used to insulate duct. Seal all seams with staples, cover with mastic and cover with embedded fiberglass reinforced mesh, cover mesh with finish coat of mastic.
7. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
8. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
9. Insulate hangers attached to duct work. Do not insulate or enclose channel, supports, etc. not directly fasten to duct.
10. Insulation termination: Butt insulation up to termination point. Apply mastic no less than 3" overlap on insulation, and 3" on metal surface. Embed fiberglass reinforced mesh overlapping full 3" of termination point, 6" strip. Cover mesh with finish coat of mastic.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge. Secure metal jacket with stainless-steel bands 12 inches on center and at end joints.

3.8 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.
   1. Flat Acrylic Finish: Two (2) finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer’s recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Inspect insulated duct, pipe, and equipment, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two (3) location(s) for each system.
   2. All insulation applications will be considered defective work if sample inspection reveals noncompliance with requirements.
   3. Remove all defective work and install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures as needed.

3.10 INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed/exposed supply, return, relief and outdoor air.
   2. Outdoor, concealed/exposed supply, return and relief air.

B. Piping Requiring Insulation:
   1. Indoor and outdoor hydronics.
   2. All pipe and appurtenances that are susceptible to sweating.
   3. All pipe and appurtenances carrying water or refrigerant, for space conditioning.
   4. Any piping not specifically scheduled for insulation below to be insulated with the code minimum required insulation.

C. Items Not Insulated:
   1. Fibrous-glass ducts.
   2. Double-wall metal ducts or lined metal ducts, both with sufficient insulation thickness to comply with adopted edition of IECC and ASHRAE/ IESNA 90.1.
   3. Factory-insulated flexible ducts.
   4. Factory-insulated plenums and casings.
   5. Flexible connectors.
   6. Vibration-control devices.
   7. Factory-insulated access panels and doors.
   8. General building exhaust duct.

3.11 DUCT AND PLENUM INSULATION SCHEDULE

A. Indoor, concealed, all duct insulation shall be of the following (Including dishwasher exhaust):
   1. Mineral-Fiber Blanket: 2 inches thick and 1.00-lb/cu. ft. nominal density.

B. Indoor, exposed (including mechanical rooms and utility rooms), rectangular, all duct insulation shall be of the following:
   1. Mineral-Fiber Board: 2 inches thick and 2.25-lb/cu. ft. nominal density.

C. Indoor, exposed round or flat oval ductwork shall be double-wall construction.

D. Outdoor (including underfloor), all duct insulation shall be any of the following:
   1. Rectangular Duct: Cellular Glass, 3 inches thick and 7.5-lb/cu. ft. nominal density. (minimum R-value of 8)
   2. Round/Flat Oval: Double wall construction (reference Metal Ducts Specification).

3.12 AIR DEVICE INSULATION SCHEDULE

A. Supply-air devices (all styles/sizes): Field insulate backside of all devices that are not factory lined:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density. Secured to air device with FSK tape, all sides.

3.13 EQUIPMENT INSULATION SCHEDULE

A. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

B. Expansion/compression/buffer tanks, Air-separators, filter feeders, etc. insulation shall be any of the following:
   1. Cellular Glass: 3 inches. (chilled water service)
   2. Phenolic: 2 inches. (chilled water service)
   3. Mineral Fiber Board: 3 inches. (hot water service)

C. Steam-to-hot water heat exchanger insulation:
   1. Mineral-Fiber board: 3” thick, 3lb/cu. ft. density.
   2. Cellular Glass: 3" thick, 7.5 lb/cu. ft density.

3.14 PIPING INSULATION SCHEDULE

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.

B. Condensate and Equipment Drains:
   1. All Pipe Sizes: Insulation shall be any of the following:
      a. Flexible Elastomeric: 1 inch thick.

C. Chilled Water Supply and Return:
   1. All Pipe Sizes: Insulation shall be any of the following:
      a. Pre-insulated Pipe: Reference Hydronic Piping Specification (for use underfloor, buried, and outdoors).
      b. Cellular Glass: (for use indoors and outdoors, not accepted in underfloor or buried). Reference schedule below for thickness.
      c. Phenolic: (for use indoors and outdoors, not accepted in underfloor or buried). Reference schedule below for thickness.

D. Hot Water Supply and Return:
   1. All pipe sizes:
      a. Mineral-Fiber (for use indoors) Reference table below for thickness.
      b. Pre-insulated Pipe: Reference Hydronic Piping Specification (for use underfloor and outdoors). Reference table below for thickness.
      c. Phenolic: (for use indoors and outdoors, not accepted in underfloor or buried) Reference Schedule below for thickness.
      d. Cellular Glass: (for use indoors and outdoors, not accepted in underfloor or buried) Reference Schedule below for thickness.

E. Phenolic Density Schedule:
   1. Indoors Concealed: 2.5 lb/ft.^{3} (Green)
   2. Indoors Exposed: 5 lb/ft.^{3} (Pink)
   3. Outdoors: 5 lb/ft.^{3} (Pink)

F. Steam and Steam Condensate, 350˚ F and below:
   1. All pipe sizes:
      a. Mineral-Fiber, Preformed pipe, Type I: 3" thick.

Insulation Thickness Schedule

Fluid	≤1.5” Pipe Size					>1.5” Pipe Size				
	Cellular Glass	Phenolic	Pre-Insulated	Mineral Fiber	Flex Elastomeric	Cellular Glass	Phenolic	Pre-Insulated	Mineral Fiber	Flex Elastomeric
Chilled Water	2”	1.5”	1.5”	N/A	N/A	2”	1.5”	1.5”	N/A	N/A
Hot Water	2”	1.5”	1.5”	1.5”	N/A	2.5”	2”	2”	2”	N/A
Steam/ Condensate	N/A	N/A	N/A	3”	N/A	N/A	N/A	N/A	3”	N/A
Condensate	N/A	N/A	N/A	N/A	1”	N/A	N/A	N/A	N/A	1”
Refrigerant Suction/Hot Gas Piping	N/A	N/A	N/A	N/A	1.5”	N/A	N/A	N/A	N/A	1.5”

G. Refrigerant Suction and Hot Gas Piping:
   1. All pipe sizes: Insulation shall be the following:
      a. Flexible elastomeric: 1-½ inch thick.

3.15 FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Ducts/Piping exposed in finished indoor areas, outdoors, underfloor and mechanical rooms.
   1. Aluminum, Stucco Embossed: 0.016 inch thick.

C. Indoor hydronic piping fitting or elbows.
   1. PVC: 0.015 inch thick.

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROLS FOR HVAC

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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. This Section includes digital control, BAS, and energy management equipment for HVAC systems, including, but not limited to, the new dishwasher exhaust fan. The resulting system shall build upon the existing Automated Logic Corporation system. Integrating different manufacturers is not acceptable under any circumstances; all microprocessor-based controllers shall be of the same manufacturer. Refer to the drawings for additional requirements. The drawing sequences of operation define specific requirements, but the scope of work is generally limited to enable/disable with status monitoring of equipment.

C. DDC systems in this building shall be hard-wire integrated with the existing front end. Field verify necessary routing to point of connection with existing DDC system.

D. Related Sections include the following:
   1. Section "Meters and Gauges" for measuring equipment that relates to this Section.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. MS/TP: Master slave/token passing.

D. PC: Personal computer.

E. PID: Proportional plus integral plus derivative.

F. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
   1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
   2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.

3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
    a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
    b. Water Flow: Plus or minus 5 percent of full scale.
    c. Water Pressure: Plus or minus 2 percent of full scale.
    d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
    e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
    f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
    g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
    h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
    i. Relative Humidity: Plus or minus 5 percent.
    j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
    l. Airflow (Terminal): Plus or minus 10 percent of full scale.
    m. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
    n. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
    o. Carbon Dioxide: Plus or minus 50 ppm.
    p. Electrical: Plus or minus 5 percent of reading.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
    1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
    2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
    3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Specification Compliance Review:
    1. Manufacturers and bidders must provide the consulting engineer with a Compliance Review of the Specifications and Addenda’s. The Compliance Review shall be a paragraph-by-paragraph review of the Specifications and schedule with the following information; “C”, “D”, or “E” marked in the margin of the original Specifications and any subsequent Addenda’s. If the manufacturer or bidder does not provide the Compliance Review to the engineer for review, with the submittal, the submittal will be subject to rejection as non-compliant.
        a. “C” Comply with no exceptions.

b. “D” Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
c. “E” Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives. Non-compliance with the specifications is grounds for rejection as unacceptable. A bid from any alternative or listed equipment manufacturer with any number of exceptions will be reason for rejection for non-compliance without further review.
d. Unless a deviation or exception is specifically noted in the Compliance Review, the manufacturer shall provide full compliance with entire specification. Deviations or exceptions taken in letters or cover letters in a bid document, subsidiary documents, by omission or by contradiction do not release the manufacturer or bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review and approved by the consulting engineer.
e. Equipment manufacturers or bidders that do not meet the specifications thru the above process will be subject to rejection without further review.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:
a. Wiring diagrams for control units with termination numbers.
b. Schematic diagrams and floor plans for field sensors and control hardware.
c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:
a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
c. Written description of sequence of operation including schematic diagram.
d. Points list.

D. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.

E. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

F. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

G. Qualification Data: For Installer.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section "Operation and Maintenance Data," include the following:
   1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
   2. Interconnection wiring diagrams with identified and numbered system components and devices.
   3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
   4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
   5. Calibration records and list of set points.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project. The installer must have a minimum of five (5) continuous years experience with the manufacturer and have an established service office within 100 miles of the project site.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE 135 for DDC system components.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.8 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Section "Fire Alarm (Expansion)" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate supply of electrical branch circuits for control units and operator workstation.

D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 CONTROL SYSTEM

A. Manufacturers:
   1. Automated Logic Corporation

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 DDC EQUIPMENT

A. Operator Workstation: One PC-based microcomputer(s) with minimum configuration as follows:
   1. Motherboard: With 4 integrated USB 2.0 and 2 USB 3.0 ports, integrated Intel Pro 10/100/1000 (Ethernet), integrated audio, bios, and hardware monitoring.
   2. Processor: Intel Quad Core I7 Processor, 3.0 GHz.
   3. Random-Access Memory: 8 GB.
   4. Graphics: Video adapter, minimum 1600 x 1200 pixels, 128-MB video memory.
   5. Monitor: 24 inches, flat panel LCD, color.
   6. Keyboard: QWERTY, 105 keys in ergonomic shape.
   7. Hard-Disk Drive: 500 GB, SATA, 7200 RPM, 6 Gb/s.
   8. DVD Read/Write Drive: 48x24x48.
   9. Mouse: Three button, optical.
   10. Uninterruptible Power Supply: 2 kVa.
   11. Operating System: Microsoft Windows 7 Professional with high-speed Internet access.
      a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
   12. Application Software:
      a. Graphical User Interface (GUI): Thin client or browser based meeting the following criteria:
         1) Web Browser's for PC's: Only a 5.x browser (Internet Explorer or Netscape Navigator) will be required as the GUI, and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet. A firewall shall be installed (as necessary) to protect the owner’s Intranet.
         2) Secure Socket Layers: Communication between the Web Browser GUI and control system server shall be encrypted using 128 bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper Text Transfer Protocol (HTTP).

b. Cross Platform Capability: The controls software (client and server) shall be operating system and hardware agnostic, compatible with Microsoft Windows, Sun Microsystems Solaris and Red Hat Linux.
c. Database creation and support with the following:
1) Database Open Connectivity: The BAS server database shall be Java DataBase Connectivity (JDBC) compatible, allowing real time access of data via the following standard mechanisms:
a) Common Object Request Broker Architecture (CORBA).
b) OLE/OPC (for Microsoft Client's/Server platform only).
c) Import/Export of the database from or to XML (extensible Markup Language).
2) Automatic and manual database save and restore.
d. System security for each operator via software password and access levels.
e. Automatic system diagnostics; monitor system and report failures.
f. Tree navigation.
g. Dynamic color graphic displays with up to 10 screen displays at once.
h. Custom graphics generation and graphics library of HVAC equipment and symbols.
i. Alarm processing, messages, and reactions.
j. Trend logs retrievable in spreadsheets and database programs.
k. Alarm and event processing.
l. Object and property status and control.
m. Automatic restart of field equipment on restoration of power.
n. Data collection, reports, and logs. Include standard reports for the following:
1) Current values of all objects.
2) Current alarm summary.
3) Disabled objects.
4) Alarm lockout objects.
5) Logs.
o. Custom report development.
p. Utility and weather reports.
q. ASHRAE Guideline 3 report.
r. Workstation application editors for controllers and schedules.
s. Maintenance management.
13. Custom Application Software:
a. English language oriented.
b. Full-screen character editor/programming environment.
c. Allow development of independently executing program modules with debugging/simulation capability.
d. Support conditional statements.
e. Support floating-point arithmetic with mathematic functions.
f. Contains predefined time variables.

B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
a. Global communications.
b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.
d. Software applications, scheduling, and alarm processing.

e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:
   a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
   b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
   c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
   d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
   e. Remote communications.
   f. Maintenance management.
   g. Units of Measure: Inch-pound and SI (metric).
4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.

2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
4. Enclosure (interior): Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
5. Enclosure (exterior): NEMA 3R.

2.5 ALARM AND OCCUPANT INTERFACE PANELS

A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch- (1.5-mm-) thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels.

B. Alarm Panels: Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
1. Alarm Condition: Indicating light flashes and horn sounds.
2. Acknowledge Switch: Horn is silent and indicating light is steady.
3. Second Alarm: Horn sounds and indicating light is steady.
4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.6 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
   1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.7 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:
   1. Available Manufacturers:
      a. Alerton.
      b. BEC Controls Corporation.
      c. Ebtron, Inc.
      d. Heat-Timer Corporation.
      e. I.T.M. Instruments Inc.
      f. MAMAC Systems, Inc.
   2. Accuracy: Plus or minus 0.5 deg F (0.3 deg C) at calibration point.
   3. Wire: Twisted, shielded-pair cable.
   4. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m). Mount sensor in an electrical box through a hole in the duct, in an easily accessible location.
   5. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
   6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
   7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
      a. Set-Point Adjustment (where indicated): Exposed.
      b. Set-Point Indication (where indicated): Exposed.
      c. Thermometer: Concealed.
      d. Color: Manufacturer’s standard**.**
   8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
   9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:
   1. Available Manufacturers:
      a. Alerton
      b. Automation Components, Inc. (ACI)
      c. Building Automation Products, Inc. (BAPI)
   2. Accuracy: Plus or minus 0.2 percent at calibration point.
   3. Wire: Twisted, shielded-pair cable.
   4. Insertion Elements in Ducts: Single point, with length equal to 1/3-distance of duct width, minimum; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).

5. Averaging Elements in Ducts: 24 inches (610 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
    a. Set-Point Adjustment (where indicated): Exposed.
    b. Set-Point Indication (where indicated): Exposed.
    c. Thermometer: Concealed.
    d. Color: Manufacturer’s standard.
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.
1. Available Manufacturers:
    a. Alerton.
    b. BEC Controls Corporation.
    c. MAMAC Systems, Inc.
    d. TCS/Basys Controls.
    e. Vaisala.
    f. Veris Industries.
2. Accuracy: 2 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F (0 to 50 deg C).
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:
1. Available Manufacturers:
    a. BEC Controls Corporation.
    b. MAMAC Systems, Inc.
    c. ROTRONIC Instrument Corp.
    d. TCS/Basys Controls.
    e. Vaisala.
    f. Veris Industries.
2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
    a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    b. Output: 4 to 20 mA.
    c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
    d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.8 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements. Manufactured by Veris Industries or equivalent.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
   1. Available Manufacturers:
      a. BEC Controls Corporation.
      b. I.T.M. Instruments Inc.
      c. Kele & Associates

2.9 GAS DETECTION EQUIPMENT

A. Manufacturers:
   1. General Monitors.
   2. Veris Industries.

B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state, non-dispersive, infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output.
   1. Operating Range: 0 to 2,000 ppm.
   2. Exposure Range: 0 to 140 deg F (without damage).
   3. Operating Humidity: 5 to 95% relative humidity.
   4. Repeatability: plus or minus 20 ppm.
   5. Maximum Drift: plus or minus 25 ppm per year.

C. Hydrocarbon Sensors: Model #S4000CH by General Monitors (no exceptions). Provide stainless steel (316) slip-stream sampling accessories (supply/return sampling tubes, sealed sensor housing, mounting plates, hardware, etc) as necessary for duct mounting in a readily accessible location. Provide with all accessories necessary for periodic testing and calibration. Coordinate with mechanical contractor.

D. Hydrogen Sulfide (H2S) Sensors: Model #S4000T by General Monitors (no exceptions). Provide stainless steel (316) slip-stream sampling accessories (supply/return sampling tubes, sealed sensor housing, mounting plates, hardware, etc) as necessary for duct mounting in a readily accessible location. Provide with all accessories necessary for periodic testing and calibration. Coordinate with mechanical contractor.

2.10 AIRFLOW MEASURING STATIONS (AFMS)

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.
   1. Manufacturers:
      a. Air Monitor Corporation.
      b. Ruskin.
   2. Model: IAQ50 (Ruskin).
   3. Frame: 6 inches × 1-3/8 inches × minimum 0.125-inch extruded aluminum.
      a. Entire assembly frame shall be flanged.
   4. Blades:
      a. Modulating Air Control:
         1) Style: Airfoil-shaped, single-piece.
         2) Action: Parallel.
         3) Orientation: Horizontal.
         4) Material: Heavy gage 6063-T5 extruded aluminum.
         5) Width: Maximum 5 inches (127 mm).
      b. Stationary Sensing:
         1) Style: Airfoil-shaped, single-piece.
         2) Orientation: Horizontal.
         3) Material: Heavy gage 6063-T5 extruded aluminum.
         4) Width: Maximum 5-1/4 inches (133 mm).
         5) Finish: Anodized.
   5. Bearings: Self-lubricating molded synthetic sleeve, turning in extruded hole in frame.
   6. Seals:
      a. Blade: Extruded rubber type for ultra-low leakage. Mechanically attached to blade edge.
      b. Jamb: Stainless steel, flexible metal compression type.
   7. Linkage: Concealed in frame.
   8. Axles: Minimum 1/2 inch (13 mm) diameter plated steel, hex-shaped, mechanically attached to blade.
   9. Mounting: Vertical.
   10. Electric Actuator: 24 V, 60 Hz, modulating, with position feedback.
   11. Digital Controller: Application specific controller. Programming logic and calibration in nonvolatile EPROM. Controller uses generic 0 - 10 vdc inputs and outputs for interface to building automation system.
   12. Flow Straightener: Aluminum honeycomb, 3/4-inch (20-mm) parallel cell, 3 inches (75 mm) deep, contained in a 5 inch deep sleeve attached to airflow frame.
   13. Finish: Mill aluminum.
   14. Assembly: Factory assembled damper/airflow monitor, actuator, and accessories, and furnish as a single factory-calibrated unit.
   15. The maximum depth of the assembly shall be no greater than 11 inches. Refer to plans for overall duct dimensions and sizes.
   16. Electrical: The airflow station shall run off of 24V power.
   17. Performance Data:
      a. Temperature Rating: Withstand -40 to 140 degrees F.
      b. Capacity: Demonstrate capacity of damper/airflow monitor.
         1) Monitor airflow within accuracy of 5 percent.

2) Perform sensing requirements in HVAC systems with velocities from 300 to 2,000 feet per minute.

c. Leakage: Maximum 2.0 cubic feet per minute per square foot at 1 inch w.g. for 48 inch × 48 inch closed damper.

Pressure Drop: Maximum 0.13 inch w.g. at 1,000 feet per minute across both damper/airflow monitor and air straightener.

18. Controls

a. The AFMS shall come complete with its own controls and, where indicated, a 24V actuator. A 0-10 V DC signal shall be provided by the AFMS to the building EMCS to monitor airflow. The AFMS shall be able to receive a 0-10 V DC signal from the EMCS to act as a setpoint adjustment when an actuator is provided.

2.11 THERMOSTATS

A. Available Manufacturers:
1. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
2. Honeywell
3. Sauter Controls Corporation.
4. TAC Erie Controls.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.
1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF" or "FAN HIGH-MED-LOW-OFF," as indicated.
2. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on weekday, Saturday, and Sunday.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:
a. Time of day.
b. Actual room temperature.
c. Programmed temperature.
d. Programmed time.
e. Duration of timed override.
f. Day of week.
g. System mode indications include "heating," "off," "fan auto," and "fan on."

D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
2. Selector Switch: Integral, manual on-off-auto.

F. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, automatic-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

G. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, automatic-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

2.12 HUMIDISTATS

A. Available Manufacturers:
1. MAMAC Systems, Inc.
2. ROTRONIC Instrument Corp.

B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.13 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
3. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
a. Belimo Aircontrols (USA), Inc.
2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:
a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.
d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.

e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.

4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
12. Run Time: 12 seconds open, 5 seconds closed.

2.14 CONTROL VALVES

A. Manufacturers:
1. Belimo
2. Parker Hannifin Corporation; Skinner Valve Division.

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 (DN 50) and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Sizing: 5-psig (35-kPa) maximum pressure drop at design flow rate or the following:
a. Two Position: Line size.
b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

D. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Lug.
2. Disc Type: **Nickel-plated ductile iron**.

3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.

E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
   1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
   2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
   3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.15 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Section "Control/Signal Transmission Media."
   1. All cable shall be return-air plenum rated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices at elevations indicated on architectural drawings or 48 inches (1220 mm) above the finished floor where requirements are not indicated.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install guards on thermostats in the following locations:
   1. Entrances.
   2. Public areas.
   3. Gymnasiums (heavy gage wire guard, chrome finish)
   4. Where indicated.

E. Install automatic dampers according to Section "Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install hydronic instrument wells, valves, and other accessories according to Section "Hydronic Piping."

H. Install refrigerant instrument wells, valves, and other accessories according to Section "Refrigerant Piping."

I. Install duct volume-control dampers according to mechanical specification sections specifying air ducts.

J. Install electronic and fiber-optic cables according to Section "Control/Signal Transmission Media."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section "Raceway and Boxes."
   1. Interior raceway shall be EMT with steel set-screw fittings. Final 18 inches (441 mm) of raceway to equipment and sensors (not junction boxes or control enclosures/panels) is permitted to be 1/2-inch flexible metallic conduit.
   2. Exterior raceway shall be intermediate metallic conduit with compression fittings, unless indicated otherwise. Where roofing supports are required, refer to Division 07 Sections and other roofing drawings specific requirements. Final 24 inches (610 mm) of raceway to equipment and sensors (not junction boxes or control enclosures/panels) is permitted to be liquid-tight flexible non-metallic conduit with compression fittings; associated elbows shall be LFNC compression water-tight fittings. LB's are not acceptable.

B. Install building wire and cable according to Section "Conductors and Cables."

C. Install signal and communication cable according to Section "Control/Signal Transmission Media."
   1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed. Route concealed cable parallel to building lines on j-hooks, bundled.
   2. Install exposed (open ceilings, occupied areas) cable in raceway.
   3. Install permanently concealed wall and partition cable in raceway with a radius bend and nylon bushing termination at an accessible location above ceiling.
   4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
   5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
   6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
   7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:
1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:

a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:
   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section "Demonstration and Training."

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Sheet metal materials.
6. Duct liner.
7. Sealants and gaskets.
8. Hangers and supports.
9. Ductwork Handling and Plenum Protection.
10. Ductwork Cleaning

B. Related Sections:
1. Mechanical Specification Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.
2. Mechanical Specification Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Mechanical Specification Section “Hangers & Supports”.
4. Mechanical Specification Section “Basic Mechanical Materials and Methods”.
5. Mechanical Specification Section “Special Conditions for Mechanical Work”.

1.3 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: Variable Volume Systems
   a. Supply Ducts: (Upstream from Air Terminal Units): 3-inch wg.
   b. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
   c. Return Ducts (Negative Pressure): 1-inch wg.
   d. Outside Air Ducts (Negative Pressure): 1-inch wg.
2. Static-Pressure Classes: Constant Volume Systems
   a. Supply Ducts: 2-inch wg.
   b. Return Ducts (Negative Pressure): 1-inch wg.
   c. Outside Air Ducts (Negative Pressure): 1-inch wg.
3. Static-Pressure Classes: Other Systems
   a. Fume Hood Exhaust (negative Pressure): 3-inch wg.
   b. General Exhaust (Negative Pressure): 1-inch wg.
   c. Relief Air: 1-inch wg.
4. Leakage Class:

a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at static pressure class.
b. Flat-Oval Supply-Air Duct: 3 cfm/100 sq. ft. at static pressure class.
c. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at static pressure class.
d. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at static pressure class.

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."

1.4 DEFINITIONS

A. Exposed: Open to view; not concealed by a ceiling.
1. Includes mechanical rooms.
2. Includes outdoors.
3. Includes crawlspace.

B. Concealed: Covered or Concealed by a ceiling, solid inaccessible or lay-in acoustical tile.

1.5 SUBMITTALS

A. Product Data: For each type of the following products:
1. Liners and adhesives.
2. Sealants and gaskets.
3. Insulation.
4. Metal.
5. Fasteners.
6. Hangers.
7. Double Wall Ductwork (Round or Flat Oval).
8. Single Wall (Round or Flat Oval).

B. Shop Drawings/Coordination Drawings: CADD generated, ¼" scale. Show fabrication and installation details for metal ducts.
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top 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 (where applicable).
13. Ceiling suspension assembly members.
14. Other systems installed in same space as ducts, including fire sprinkler piping; electrical conduits; cable trays; hydronic, domestic, and sanitary piping; and structural members.
15. Ceiling-and-wall-mounting access doors and panels required to provide access to dampers and other operating devices.
16. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Welding certificates.

D. Field quality-control reports.

E. Field Pressure test Reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

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, 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, 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, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Seal all duct transverse joints, longitudinal seams, flanges, and duct wall penetrations (SMACNA Seal Class-A regardless of static pressure construction class).

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. McGill Airflow LLC.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. 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, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. 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, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Thickness:
      a. 1 inch, minimum for INDOOR, exposed ducts in conditioned spaces.
      b. 1-1/2 inches, minimum for INDOOR ducts in unconditioned spaces, including, but not limited to return-air plenums and mechanical rooms.
      c. 2-1/2 inches, minimum for OUTDOOR ducts.
   3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   4. Coat insulation with antimicrobial coating.

G. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Traverse (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."

H. Seal all duct transverse joints, longitudinal seams, flanges and duct wall penetrations (SMACNA Seal Class-A regardless of static pressure construction class).

2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: **Spiral seams** complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class. **Longitudinal-seams (snap-lock) are not acceptable for any application.**
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Lindab Inc.
      b. McGill AirFlow LLC.
      c. SEMCO Incorporated.
      d. Spiral Pipe of Texas
      e. Direct Duct

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, 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. Seams: Fabricate according to the **spiral seam requirements** of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." **Longitudinal-seams (snap-lock) are not acceptable for any application, except where indicated below.**

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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. Seal all duct transverse joints, longitudinal seams, flanges and duct wall penetrations (SMACNA Seal Class-A regardless of static pressure construction class).

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Spiral Pipe of Texas
5. Direct Duct

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct) of the inner duct.

C. Outer Duct Fabrication Requirements: **Spiral seams** complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class. **Longitudinal-seams (snap-lock) are not acceptable for any application.**
1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "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."
   a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
2. Seams: Fabricate according to the **spiral seam requirements** of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "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." **Longitudinal-seams (snap-lock) are not acceptable for any application, except where indicated below.**
   a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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."

D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Thickness:
      a. 1 inch, minimum for INDOOR, exposed ducts in conditioned spaces.
      b. 1-1/2 inches, minimum for INDOOR ducts in unconditioned spaces, including, but not limited to return-air plenums and mechanical rooms.
      c. 2-1/2 inches, minimum for OUTDOOR ducts.
   3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   4. Coat insulation with antimicrobial coating.
   5. Cover insulation with polyester film complying with UL 181, Class 1.

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, rust, stains, discolorations, and other imperfections. All ductwork shall be a minimum of 24 gage, with a minimum thickness of 0.023 inches. Where in the SMACNA “HVAC Duct Construction Standards-Metal Flexible” it indicates that a lighter gage may be utilized, a minimum of 24 gage shall be used.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60 (Z180).
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60 (Z180).
   2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 4 mils thick on opposite surface.
   3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. 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.

H. 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.

I. Plastic Connectors are not acceptable.

2.6 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation; Insulation Group.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
      e. Maximum Thermal Conductivity:
         1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
         2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916. Equal to DP 2502.

B. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer. Equal to CS-10.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
   6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
   7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
      a. Fan discharges.
      b. Intervals of lined duct preceding unlined duct.
      c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
   8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 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. All products are to contain low V.O.C. as defined/governed by LEED IEQ 4.1 and 4.2 (Regardless of project type).

B. Water-Based Joint and Seam Sealant (for indoor installation):
   1. Application Method: Brush on.
   2. Solids Content: Minimum 68 percent.
   3. Water resistant.
   4. Mold and mildew resistant.
   5. VOC: less than 30 g/l (less water).
   6. Maximum Static-Pressure Class: 15-inch wg, positive and negative.
   7. Service: Indoor.
   8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
   9. DP 1020 or approved equal.

C. Water-Based Joint and Seam Sealant (for outdoor installation):
   1. Application Method: Tube application or dry tooling.
   2. Service Temp Range (degrees F): -40 to 180.
   3. Water resistant.
   4. Mold and mildew resistant.
   5. Service: Indoor.
   6. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
   7. Sonolastic NP-1 or approved equal.

D. Flanged Joint Sealant: Comply with ASTM E-84.
   1. General: Butyl gasket tape.
   2. Type: Butyl Rubber.
   3. Service Temperature: Minus 40°F to 245°F
   4. Pressure Class: All
   5. DP 1040

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

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.
   2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 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. All ductwork sizes indicted on drawings are internal, free area dimensions. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

H. Coordinate layout with suspended ceiling, fire-and smoke-control dampers, lighting layouts, and similar finished work.

I. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws. Sealant of seems/joints to include (but not limited to): all joints (including gasketed joints) metal seams, taps, any connections, etc.

J. Paint interiors of metal ducts that do not have duct liner, for 24 inches (600 mm) upstream of return air registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

K. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

L. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness. Compression of insulation by other trades (pipe, conduit, etc) is not acceptable.

M. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

N. 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 of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

O. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Mechanical Specification Section "Air Duct Accessories" for fire and smoke dampers.

P. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

Q. Horizontal ductwork in mechanical rooms must be installed a minimum of 8’-0” AFF.

R. All duct floor penetrations must have a water-tight, continuous concrete curb surrounding them. Minimum curb size shall be 3-1/2” tall X 3-1/2” wide.

3.2 DUCTWORK HANDLING AND PLENUM PROTECTION

A. All ductwork shall be delivered to site and stored with all openings protected from the elements. Protection to include 2.5 mil thick polyethylene plastic film secured with tape or integral elastic band.

B. Each segment/section of ductwork installed is to be appropriately protected from elements.

C. Any ductwork damaged during delivery, installation, or at any time during construction will be removed from job and replaced.

D. Ductwork found onsite (installed or stored) without approved protection will be removed from job and replaced.

E. Ductwork installed exposed to the elements to be sealed (joints and seems) immediately after installation. Any ductwork not sealed is susceptible to rejection and removed from job.

F. Under no circumstances shall insulation be applied to ductwork prior to the building being fully dried in (i.e.: building sealed, windows and roof installed, etc). Any ductwork being insulated prior to building dry-in is susceptible to rejections and removed from job.

G. If ductwork is found onsite not protected or the newly installed ductwork is deemed as dirty, engineer can elect for the contractor to clean all duct at no cost to the owner per NADCA 1992.

3.3 SEAM AND JOINT SEALINGS

A. Seal all duct transverse joints, longitudinal seams, flanges and duct wall penetrations (SMACNA Seal Class-A regardless of static pressure construction class).

3.4 HANGERS AND SUPPORT INSTALLATION

A. Comply with SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible,” Chapter 4 “Hangers and Supports,” unless otherwise indicated.
   1. Support rectangular ducts greater than 36 inches with width with trapeze threaded rod and angle or channel supports. Straps not acceptable.
   2. Rectangular Duct Hangers Exposed to View: Threaded rod and channel supports (do not use steel angles).

B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.

C. Hanger Spacing: Comply with SMACNA’s “HVAC Duct Construction Standards-Metal and Flexible,” Table4-1 (Table 4-1M), “Rectangular Duct Hangers Minimum Size,” and Table 4-2, “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. Elbows 36” and larger to be individually supported.

D. 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. Support vertical ducts in a manner that introduces minimal weight onto the roof curb flange.

E. 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.
   1. Do not attach hangers to metal deck roof assemblies with built-up insulation only (no concrete). Attach only to structural steel members.

3.5 CONNECTIONS

A. Make all connections to all fan-bearing equipment with flexible connectors complying with Specification 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. Reference detail for specific additional items required.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   1. Comply with SMACNA’s “HVAC Air Duct Leakage Test Manual.” Leakage Class defined in previous sections of specification. Amount of ductwork to be tested to be determined by Engineer or Field Inspector).
   2. Test the following systems:
      a. Medium Pressure Ductwork (3-Inch wg), up to Air Terminal (branch taps included): Test representative duct sections totaling no less than 100 percent of total installed duct area.
      b. Low Pressure Supply Ducts: Test representative duct totaling no less than 20 percent of total installed duct area.
      c. Return Ducts: Test representative duct sections totaling no less than 20 percent of total installed duct area.
      d. Exhaust Ducts: Test representative duct sections totaling no less than 20 percent of total installed duct area.
      e. Outdoor Air Ducts: Test representative duct sections totaling no less than 20 percent of total installed duct area.
      f. Grease Laden/Dishwasher Exhaust: Test representative duct sections per IMC “Light Test.”
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before insulation application.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Contractor to disassemble, reassemble and seal segments of systems to accommodate leakage testing and for compliance with test requirements / leakage rates.

E. All testing equipment to be calibrated (by manufacturer) within 3 years of onsite duct pressure testing. Documentation to be provided for verification of certification to Engineer through submittal process.

F. Test Coupons: Cut out three (3) 4x4" test coupons in random locations selected by the design engineer for verification of gage thickness. Coupons shall be taken at the time of pressure testing.

G. Prepare test and inspection reports.

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as follows:
   1. Acid-Resistant (Fume-Handling) Ducts:
      a. Type 304, stainless-steel sheet – welded.
      b. Exposed to View: No. 4 finish.
      c. Concealed: No. 2D finish.
   2. Moist Environment Ducts: Aluminum.
   3. Spaces with pools, spas, hot tubs or water features: Aluminum.
   4. Kitchen Exhaust – Reference applicable specification.

B. Intermediate Reinforcement:
   1. Galvanized-Steel Ducts: Galvanized steel.
   2. Stainless-Steel Ducts: Galvanized steel.
   3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

C. Liner:
   1. Transfer Ducts: Fibrous glass, Type I 1 inch thick.

D. Double-Wall Duct Schedule:
   1. All exposed Round/Flat Oval Ductwork.

E. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-2, "Rectangular Elbows".
      a. Velocity 1000 fpm 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) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
         3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support Elbows."
      c. Velocity 1500 fpm (7.6 m/s) or Higher:
         1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
         3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows.
   2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 3-3, "Round Duct Elbows".

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
   1) Velocity 1000 fpm 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 and five segments for 90-degree elbow.
b. Round Elbows, 12 inches and smaller 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 2-6, "Branch Connections."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Side takeoff fitting.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or higher: 45-degree lateral.

3.9 CLEANING NEW SYSTEMS

A. If ductwork is found onsite not protected or the newly installed ductwork is deemed as dirty, engineer can elect for the contractor to clean all duct at no cost to the owner per NADCA 1992.

B. System Cleaning: (If required)
1. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
2. Provide service openings (approved duct access doors), as required, for physical and mechanical entry during cleaning and for inspection. All duct access doors to be installed prior to any duct pressure tests.
   a. Removed and reinstall ceiling sections to gain access during the cleaning process.
3. Vent vacuuming system to the outside. Include filtration to conation debris removed from HVAC systems, and locate exhaust down wind and minimum of 20 feet away from air intakes and other points of entry into building.
4. Clean the following metal duct systems by removing surface contaminants and deposits:
   a. Air outlets and inlets (registers, grilles and diffusers).
   b. Supply, return and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers and drive assemblies.
   c. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   d. Coils and related components.
   e. Return-air ducts, dampers and actuators except in ceiling plenums and mechanical equipment rooms.
   f. Supply-air ducts, dampers, actuators and turning vanes.
5. Mechanical Cleaning Methodology:

a. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
b. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
c. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner or duct accessories.
d. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do no permit duct liner to get wet.
e. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Cleanliness Verification:
   a. Visually inspect metal ducts for contaminants.
   b. Where contaminants are discovered, re-clean and re-inspect ducts.

END OF SECTION

SECTION 23 33 00

DUCT ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Backdraft dampers.
   2. Manual-volume dampers.
   3. Fire dampers
   4. Fire and smoke dampers.
   5. Turning vanes.
   6. Duct-mounted access doors and panels.
   7. Flexible ducts.
   8. Flexible connectors.
   9. Side takeoff fittings.
   10. Duct accessory hardware.
   11. Motorized control dampers.

B. Related Sections include the following:
   1. Specification Section "Access Doors" for wall- and ceiling-mounted access doors and panels.
   2. Specification Section "Louvers and Vents" for intake and relief louvers and vents connected to ducts and installed in exterior walls.
   3. Specification Section "Air Terminals" for constant-volume and variable-air-volume control boxes and reheat boxes.
   4. Specification Section "Air Inlets and Outlets."
   5. Specification Section "HVAC Controls" for electric damper actuators.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Backdraft dampers.
   2. Manual-volume dampers.
   3. Fire dampers.
   4. Fire and smoke dampers.
   5. Duct-mounted access doors and panels.
   6. Flexible ducts.
   7. Motorized control dampers.
   8. Side takeoff fittings

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA standards:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT DAMPERS

A. Description: Suitable for horizontal or vertical installations.

B. Frame: 0.063-inch thick extruded aluminum, with mounting flange.

C. Blades: 0.050-inch thick aluminum sheet.

D. Blade Seals: Felt.

E. Blade Axles: Nonferrous.

F. Tie Bars and Brackets: Aluminum.

G. Return Spring: Adjustable tension.

2.3 MANUAL-VOLUME DAMPERS

A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
   1. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

B. Standard Volume Dampers: Multiple- or single-blade, opposed-blade design, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
   1. Roll-Formed Steel Blades: 0.064-inch thick, galvanized, sheet steel.
   2. Blade Axles: Galvanized steel.
   3. Tie Bars and Brackets: Galvanized steel.
   4. 1-1/2-inch insulation buildout with locking quadrant.

C. Low-Leakage Volume Dampers: Multiple- or single-blade, opposed-blade design, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch thick, galvanized, sheet steel.
3. Blade Seals: Felt.
4. Blade Axles: Galvanized steel.
5. Tie Bars and Brackets: Galvanized steel.
6. 1-1/2-inch insulation buildout with locking quadrant.

D. Jackshaft: 1-inch diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.

E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

F. Remotely Operated Damper Accessories:
1. Galvanized steel rotary cable with termination for adjustment either at the diffuser face or at a wall- or ceiling-recessed box/cup as shown on drawings. Secure other cable end to damper worm gear assembly. Cable must be one-piece with no linkages along the length. Provide mounting clips to support cables at all changes in direction and at 3-foot intervals.

2.4 FIRE DAMPERS

A. General: Labeled to UL 555 (sixth edition). Ruskin Model D1BD2-B (or design engineer approved equivalent). Dampers shall be marked with a UL-Classified fire protection rating and marked “For Use in Dynamic Systems”.

B. Fire Rating: One and one-half and/or three hours as indicated.

C. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

D. Mounting Sleeve: Provide factory-mounted sleeve and retaining angles.
1. Minimum Thickness (Sleeve shall not extend more than 6" past wall or floor without factory installed access door): 16 gauge and length to suit application.

E. Mounting Orientation: Vertical or horizontal as indicated.

F. 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.

G. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.

H. Fusible Link: Replaceable, 165 deg F rated as indicated.

2.5 COMBINATION FIRE / SMOKE DAMPERS (SFD)

A. General: Labeled to UL 555/UL 555S (sixth and fourth edition respectively) Combination fire and smoke dampers shall be labeled for one-and-one-half-hour rating to UL 555S. Provide Class II leakage rating. Dampers shall be marked with a UL-classified fire rating. Ruskin FSD-60 or approved equivalent. The SFD shall be listed to operate from the fire alarm control panel (FACP). Each SFD shall have an associated smoke detector that shall be addressable from the FACP. The smoke detector shall be provided by the Fire Alarm

Contractor and installed by the Electrical Contractor. Coordinate damper installation with these trades.

B. Electric Fusible Link (EFL): 165 or 212 deg F rated as applicable.

C. Frame and Blades: 16 gauge, galvanized, sheet steel. Damper blades shall be airfoil-shaped, single-piece construction, with blade seals mechanically locked into blade edge (adhesive clip-on seals are not acceptable). Ruskin FSD-60 or equivalent. Damper blades shall be minimum 14 gauge. SFD's installed off vertical chases shall have vertical airfoil blades (Ruskin FSD 60-V or equivalent).

D. Mounting Sleeve: Factory-installed, 16 gauge, galvanized, sheet steel; length to suit wall or floor application. Sleeve shall not extend more than 6" past wall or floor without factory installed access door. SFD shall be capable of mounting on either side of wall and working with airflow in either direction. Provide manufacturer-recommended duct-to-sleeve joints.

E. Electric controlled closure is not less than 7 seconds or more than 10 seconds to prevent HVAC and duct damage. Damper shall have local reset button and shall have automatic reset after test, smoke detection or power failure conditions. Damper shall close upon loss of power or AHU shut down. Actuator shall be 120V.

F. Provide with stainless steel jam seals and bearings. (Bronze bearings are not acceptable)

G. Furnish and install dampers according to manufacturer's instructions and in compliance with the latest edition of the SMACNA Duct Manual and NFPA Standards (90, 92A, and 92B).

2.6 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch wide, curved blades set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into side strips suitable for mounting in ducts.

2.7 DUCT-MOUNTED ACCESS DOORS AND PANELS

A. Manufactures:
   1. Greenheck
   2. Flexmaster
   3. Elgens
   4. No exceptions

B. Ratings
   1. Differential Pressure
      a. Access doors shall have a maximum differential pressure rating of 4.5 in.wg.

C. Construction
   1. Frame
      a. Access door shall be constructed of 27 ga. Galvanized steel on sizes up to 12 in. x 12 in. On sizes 14 in. x 14 in. and larger shall be constructed of 22 ga. Galvanized steel.
   2. Door Panel: Door panel is constructed of 24 ga. Galvanized steel on both sides of the insulation.
   3. Insulation: Insulation is 1 in. fiberglass.

4. Gasket: Gasket is ½ in. wide dual gasket (compressible synthetic type). Gasket is to be used door to frame and frame to duct.
5. Hinge: Continuous piano style.
6. Latches: Latches is plated steel with galvanized steel strikes.
7. Finish: Mill finish is standard.

2.8 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.

C. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

D. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp, and 440 lbf/inch in the filling.

2.9 INSULATED FLEXIBLE DUCT, LOW PRESSURE

A. Manufacturers:
1. Flexmaster type 1M UL181 Class I Air Duct.
2. Thermaflex MK-E
3. No exceptions

B. The duct shall be constructed of a CPE fabric supported by helical wound galvanized steel.

C. The internal working pressure rating shall be at least 6" w.g. positive and 4" w.g. negative, with a bursting pressure of at least 2-1/2 times the working pressure.

D. The duct shall be rated for a velocity of at least 4000 feet per minute.

E. The duct must be suitable for continuous operation at a temperature range of -20 deg F to +250 deg F.

F. Acoustical performance, when tested by an independent laboratory in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1*, Section 3.0, Sound Properties, shall be as follows:
1. The insertion loss (dB) of a 6-foot length of straight duct when tested in accordance with ASTM E 477, at a velocity of 500 feet per minute, shall be at least:

Octave Band	**2**	**3**	**4**	**5**	**6**	**7**
Hz.	125	250	500	1000	2000	4000
6" diameter	11	33	36	37	19	14
8" diameter	13	35	34	37	29	17

Octave Band	2	3	4	5	6	7
12" diameter	10	26	26	32	24	11

G. Factory insulate the flexible duct with fiberglass insulation. The R-value shall be at least 6 at a mean temperature of 75 deg F.

H. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim (FSK) having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E 96, Procedure A.

2.10 SIDE TAKEOFF FITTINGS

A. Provide Flexmaster Model STOD or SBMD takeoff for sheet metal for all taps connecting to flex duct, except for air devices with OBD's and flow bar. For devices with OBD, use Flexmaster Model STO- or SBM no exceptions.

B. The side takeoff fittings shall maintain a ratio of 1:1 of inlet to outlet on all units over 7-inch diameter to allow proper sizing of the duct system.

C. Model STOD side takeoff shall have a 1-inch offset rear edge for enhanced pressure drop characteristics and 1-1/2-inch insulation buildout with locking hand quadrant.

D. Fittings shall have a 1-inch-wide prepunched mounting flange with corner clips and adhesive gasket for minimal leakage and ease of installation.

E. The fittings shall be constructed of a two-piece 26-gauge G-90 galvanized steel body and collar.

F. The overall length of the fitting shall be 13 inches with or without damper to reduce turbulence in the airstream.

G. The round outlet shall be provided with a rolled stiffener bead for strength and ease of installation and sealing of spiral and flexible ductwork joints.

2.11 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 length to suit duct insulation thickness.

B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.

D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.12 MOTORIZED CONTROL DAMPERS

A. Manufacturers:
   1. Greenheck.
   2. Nailor Industries Inc.

3. Ruskin Company.
4. Pottorff.

B. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch thick, galvanized-steel damper blades with maximum blade width of 8 inches.
1. Secure blades to ½-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Provide parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is being held by torque of 50 in.×lbf (5.6 N×m); when tested according to AMCA 500D.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.

B. When installing volume dampers in lined duct, avoid damage to and erosion of duct liner.

C. Install manual volume dampers at all main branch lines for ease of balancing.

D. Provide test holes at fan inlet and outlet and elsewhere as indicated.

E. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
1. Install fusible links in fire dampers.

F. Install mounting angles, minimum of 1 ½ "x 1 ½ "x 20 gauge steel on both sides of SFD or FD.

G. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, smoke-fire dampers, turning vanes, and equipment.

H. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting and maintaining accessories and terminal units.
1. Install access panels on side of duct where adequate clearance is available.
2. Label access doors according to Specification Section “Mechanical Identification.”

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Specification Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

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 the following:
   1. Ceiling-mounting ventilators.
   2. Centrifugal roof ventilators
   3. Destratification fans
   4. In-line centrifugal fans.
   5. Propeller fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

C. Fan Unit Schedule: The following information is described in an equipment schedule on the Drawings.
   1. Fan performance data including capacities, static pressure, sound power characteristics, motor requirements and electrical characteristics.
   2. Fan arrangement, including wheel configuration inlet and discharge configurations and required accessories.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages and operators.
   6. Roof curbs.
   7. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components and location and size of each field connection.
   1. Wiring Diagrams: Power, signal and control wiring.
   2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and base weights.

C. Coordination Drawings: Show roof penetration requirements and reflected ceiling plans drawn to scale and coordinating roof penetrations and units mounted above ceiling. Show the following:
   1. Roof framing and support members relative to duct penetrations.
   2. Ceiling suspension assembly members.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Maintenance Data: For power ventilators to include in maintenance manuals specified in Division 1 Section “Operation and Maintenance Data”.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMAC Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

E. Listing and labeling: Provide electrically operated fixtures specified in this section that are listed and labels.
   1. The terms “Listed” and “Labeled”. As defined in the Nations Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing laboratory” (NTRL) as defined in OSHA Regulation 1910.7.

F. UL Standard: Provide Power Ventilators that comply with UL 762, grease laden air at 300 deg. F where applicable (kitchen exhaust).

G. Warranty: The manufacturer’s standard warranty shall be for a period of 12 months from the date of Substantial Completion. Warranty is limited to manufacturer defects only. The warranty shall include parts and labor during this period.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, are required for moving to final location, according to manufacturer’s written instructions.

C. Lift and support units with manufacturer’s designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Specification Section “Cast-In-Place Concrete”.

C. Coordinate installation of roof curbs, equipment supports and roof penetrations. These items are specified in Specification Section “Roof Accessories”.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: One set for each belt-driven unit.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field Measurements. Verify clearances.

B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated and fans have been commissioned.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Centrifugal Roof Ventilators:
      a. Cook, Loren Company
      b. Envirofan
      c. Greenheck Fan Corp.
      d. Leading Edge

2.2 CEILING-MOUNTING VENTILATORS

A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

B. Housing: Steel, lined with acoustical insulation

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor and fan wheel shall be removable for service.

D. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

2. Filter: Washable aluminum to fit between fan and grille.
3. Isolation: Rubber-in-shear vibration isolators.
4. Manufacturer's standard roof jack or wall cap and transition fittings.

G. Capacities and Characteristics: Refer to drawing schedules.

2.3 CENTRIFUGAL ROOF VENTILATORS – DOWNBLAST

A. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base and accessories.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, two-piece, aluminum base with venture inlet cone.

C. Fan Wheels: aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: turned, ground, and polished stainless steel; keyed to wheel hub.
2. Shaft Bearings: Heavy-duty re-greasable bail type in a pillow block cast iron housing, selected for a minimum L50 life in excess of 200,000 hours.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.
5. Belts: Oil and heat resistant, nonstatic.

E. Accessories: The following items are required as indicated:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent (required on direct drive fans only).
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base. Built in cant and mounting flange.
1. Configuration: Built-in cant and mounting flange.
2. Overall Height: 18 inches
3. Pitch Mounting: Manufacture curb for roof slope, if necessary.
4. Metal Liner: Galvanized steel.

2.4 CENTRIFUGAL ROOF VENTILATORS – UPBLAST

A. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories. Grease laden fans to comply with UL 762 Grease Laden Air.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, two-piece, aluminum base with venturi inlet cone.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground and polished stainless steel; keyed to wheel hub.

2. Shaft Bearings: heavy-duty re-greasable ball type in a pillow block cast iron housing, selected for a minimum L50 life in excess of 200,000 hours.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

E. Accessories: The following items are required as indicated:
1. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through in internal aluminum conduit.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Built-in cant and mounting flange.
2. Overall Height: 18 inches
3. Pitch Mounting: Manufacture curb for roof slope, if necessary.
4. Metal Liner: Galvanized steel.
5. Vented Curb Extension, with hinged curb cap.

2.5 DESTRATIFICATION FANS

A. Ceiling Fans 60” diameter 3 blade fan, dynamically balanced with permanently lubricated ball bearing motor, U.L. listed (UL 507), with all necessary hooks and supports for a complete installation. Provide solid state speed controllers and secondary support cable.

B. Wall Mount Circulators: 24” 3-blade oscillating fan. Wall bracket, 2-speed motor, powder coated for guards, heavy duty pull chain, 45°-90° sweep. Safety cable mounting kit.

2.6 IN-LINE CENTRIFUGAL FANS (TUBULAR)

A. Description: In-line, direct or belt-driven (as scheduled on the drawings) centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets and accessories.

B. Housing: Spilt, spun aluminum with aluminum straightening vanes, inlet and outlet flanges and support bracket adaptable to floor, side wall or ceiling mounting.

C. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, air foil blades welded to aluminum hub.

F. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2 by 1 inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

G. Capacities and Characteristics: Refer to drawing schedules.

2.7 IN-LINE CENTRIFUGAL FANS (SQUARE)

A. Description: In-line, direct driven (as scheduled on the drawings) centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets and accessories.

B. Housing: Insulated and galvanized with inlet and outlet flanges and support bracket adaptable to floor, side wall or ceiling mounting.

C. Direct-Driven Units: ECM Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

D. Fan Wheels: Aluminum, backward inclined air foil blades welded to aluminum hub.

E. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Companion Flanges: For inlet and outlet duct connections.
   3. Housing Insulation.
   4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

F. Capacities and Characteristics: Refer to drawing schedules.

2.8 PROPELLER FANS

A. Description: Direct-or belt-driven (as scheduled on the drawings) propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly and accessories.

B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

B. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

C. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factor set pitch angle of blades.

D. Belt-Drive Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
   1. Service Factor Based on Fan Motor Size: 1.4.
   2. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.
   3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
      a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.
   4. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
   5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   7. Belt Guards: Fabricate of steel motors mounted on outside of fan cabinet.

E. Accessories:
   1. Gravity Shutters: Aluminum blades in aluminum fame; interlocked blades with nylon bearings.

2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Weathershield Hood: Galvanized steel to match fan and accessory size.
5. Weathershield Front Guard: Galvanized steel with expanded metal screen.

F. Capacities and Characteristics: Refer to drawing schedules.

2.9 MOTORS

A. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.

B. Enclosure Type: The following features are required as indicted.
1. Open drip proof motors where satisfactorily housed or remotely located during operation.
2. Guarded drip proof where exposed to contact by employees or building occupants.

C. All motors shall be pre-wired to the disconnect at the factory.

2.10 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, “Methods for Calculating Fan Sound Ratings from Laboratory Test Data.” Factory test fans according to AMCA 300, “Reverberant Room Method for Sound Testing of Fans.” Label fans with AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation and efficiency by factory tests and ratings according to AMCA 210, “Laboratory Methods of Testing Fans for Rating.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support inline fans with galvanized all thread and spring isolators with a static deflection of 1 inch.

C. Support suspended units from structure using galvanized threaded steel rods and spring hangers.

D. Secure roof-mounting fans to roof curbs with stainless steel hardware. Anchor fan to curb with a minimum of two (2) fasteners per side. Refer to Specification Section “Roof Accessories” for installation of roof curbs.

E. Ceiling Units: Suspect units from structure; use steel wire or metal straps.

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Specification Section “Mechanical Identification.”

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Mechanical Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors for all fans; no exceptions. Flexible connectors are specified in Specification Section “Duct Accessories.”

B. Install duct adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Specification Section “Grounding and Bonding.”

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Verify that shipping, blocking and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction and verity fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verity lubrication for bearings and other moving parts.
   8. Verity that manual and automatic volume control and fire and smoke dampers in connected ductwork system are in fully open positions.
   9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
   10. Shut unit down and reconnect automatic temperature-control operators.
   11. Remove and replace malfunctioning units and retest as specified above.

B. Starting Procedures:
   1. Energize motor and adjust fan to indicated rpm.
   2. Measure and record motor voltage and amperage.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Shut unit down and reconnect automatic temperature-control operators.

F. Refer to Specification Section “Testing, Adjusting and Balancing” for testing, adjusting, and balancing procedures.

G. Replace fan and motor pulleys as required to achieve design airflow.

H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Specification Section “Testing, Adjusting and Balancing” for testing, adjusting and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.5 CLEANING

A. On completion of installation, internally clean fans according to manufacturer’s written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burns, dirt and construction debris and repair damaged finished.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain power ventilators.
   1. Train owner’s maintenance personnel on procedures and schedules for starting and stopping, troubleshooting servicing, and maintaining equipment and schedules.
   2. Review data in maintenance manuals. Refer to Specification Section “Closeout Procedures.”
   3. Review data in maintenance manuals. Refer to Specification Section “Operation and Maintenance Data.”
   4. Schedule training with Owner, through Architect, with at least seven days’ advance notice.

3.7 COMMISSIONING

A. Final Checks before Startup: Perform the following operations and checks before startup:
   1. Verify that shipping, blocking and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters and disconnects.
   3. Perform cleaning and adjusting specified in this Section.
   4. Disconnect fan drive from motor, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts and install belt guards.
   5. Lubricate bearings, pulleys, belts and other moving parts with factory-recommended lubricants.
   6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
   7. Disable automatic temperature-control operators.

B. Starting Procedures for fans are as follows:
   1. Energize motor; verify proper operation of motor, drive system and fan wheel. Adjust fan to be indicated RPM.
   2. Measure and record motor voltage and amperage.

C. Shut unit down and reconnect automatic temperature-control operators.

D. Refer to Specification Section “Testing, Adjusting and Balancing,” for procedures for air-handling-system testing, adjusting and balancing.

E. Replace fan and motor pulleys as required to achieve design conditions.

END OF SECTION

SECTION 23 36 50

AIRFLOW MONITORS

PART 1 - PRODUCTS

1.1 SECTION INCLUDES

A. Factory assembled and tested airflow monitor for indoor air quality complete with ventilation controller. Unit shall be installed within ductwork to measure air flow rate.

1.2 RELATED SECTIONS

A. Specification Section “Metal Ducts”, if applicable.

B. Specification Section “Instrumentation and Controls for HVAC”, if applicable.

1.3 REFERENCES

A. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data.
   1. Include leakage, pressure drop, and sample calibration curves.
   2. Indicate materials, construction, dimensions, and installation details.
   3. Verify calibration performed in AMCA registered laboratory.

B. Operation and Maintenance Data: For airflow monitors to include in O&M manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Manufacturer: Individually calibrated to proper airflow set points.

B. Airflow Monitor Capacity: Demonstrate airflow monitor capacity.
   1. Monitor airflow within accuracy of 2 percent.
   2. Perform sensing requirements in HVAC systems with velocities from 0 to 5,000 feet per minute.

C. Assembly to meet AMCA Class 1 leakage (3 cfm/sq ft at 1” w.c.).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.

C. Handling: Handle and lift airflow monitors in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Ebtron GTx116-P

B. Air Monitor

2.2 AIRFLOW MONITORS

A. Provide combination airflow and air temperature measurement devices where indicated on the plans. Fan inlet sensors shall not be substituted for duct or plenum mounted probes.

B. Each measuring device shall consist of multi-point sensors in one or more probe assemblies with a maximum of one to sixteen sensor nodes per location, and a single remotely mounted microprocessor-based transmitter for each measurement location. Each transmitter shall have a display capable of simultaneously displaying both airflow and temperature. Airflow rate shall be field configurable to be displayed as velocity or volumetric rates, selectable as IP or SI units. Each transformer shall operate on 24 VAC and be fused and protected from over voltage, over current and power surges. All integrated circuitry shall be temperature rated as 'industrial-grade.' No electronic components other than the sensor elements shall be located at the sensing node. Each ducted sensor probe shall have an integral, U.L. Listed, plenum rated cable. Cable jackets and conductor insulation shall be FEP, Teflon-FEP or Neoflon-FEP. Conductor insulation for internal probe wiring shall be made from Kynar. Each transmitter shall include Field Calibration Wizard software which allows for a one or two point field adjustment to factory calibration for installations that require adjustment.

C. Each sending point shall independently determine the airflow rate and temperature at each node, which will be equally weighted in calculations by the transmitter prior to output as the cross-sectional average. Devices which average multiple non-linear variables are not acceptable. Pitot arrays are not acceptable. Devices using chip-in-glass, epoxy-coated or diode-case chip thermistors are not acceptable. Vortex-shedding devices are not acceptable.

D. Each independent airflow sensor shall have a laboratory accuracy of +/-2% of Reading over the entire calibrated airflow range of 0 to 5,000 fpm (25.4 m/s), and be wind tunnel calibrated at 16 points against air velocity standards that are traceable to NIST.
   1. Devices whose accuracy is the combined and independent accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the calibrated range.

E. Each independent temperature sensor shall have a calibrated accuracy of +/-0.14°F (0.08°C) over the entire operating temperature range of -20°F to 160°F (-28.9 °C to 71°C) and be calibrated at 3 temperatures against standards that are traceable to NIST.

2.3 CONTROLS

A. A 0-10 V DC signal shall be provided by the AFMS to the building EMCS to monitor airflow. Controls vendor to provide 24 V DC for power.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Factory test airflow monitor to assure proper operation.

PART 3 - PRODUCTS

3.1 EXAMINATION

A. Inspect areas to receive airflow monitors. Notify the Engineer of conditions that would adversely affect the installation or subsequent utilization of the airflow monitors. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install airflow monitors at locations indicated on the drawings and in accordance with manufacturer's installation instructions.

B. Install airflow monitors square.

C. Do not compress or stretch airflow monitor frame into duct or opening.

D. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

END OF SECTION

SECTION 23 81 80

GREASE/DISHWASHER DUCTS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ducts for conveying grease laden and or condensate and all related items. These include the following:
   1. Rectangular and round grease/condensate hood ducts.
   2. Fire rated duct wrap.

1.2 SUBMITTALS

A. Shop Drawings: CAD-generated and drawn to ¼ inch equals 1 foot1:50 scale. Show fabrication and installation details for metal ducts.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Elevations of top and bottom of ducts.
   4. Dimensions of main duct runs from building grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated and other partitions.
   9. Equipment installation based on equipment being used on Project.
   10. Duct accessories, including access doors and panels.
   11. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

B. Welding certificates.

C. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.A111, "Structural Welding Code--Steel," for hangers and supports AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; (Not less than No. 16 MSG in thickness.)

C. Stainless Steel: ASTM A 480/A 480M, Type 304 (No. 16 MSG in thickness.)

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches100 mm thick.
   2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches100 mm thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
   1. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

C. Duct Attachments:
   1. Minimum 12 gauge copper-coated steel insulation pins; galvanized steel speed clips, minimum 1-1/2 inch square or 1-1/2 inch diameter round, or equivalent sized insulated cup-head pins.
   2. Carbon steel or stainless steel banding material, minimum ½ inch wide, minimum 0.015 inch thick, with steel banding clips.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
   1. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
   2. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
   3. Supports for carbon-steel ducts: Carbon-steel support materials.

2.4 RECTANGULAR OR ROUND GREASE DUCT OR DISHWASHER HOOD DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
   1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
   2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. All seams, joints, penetrations, and duct to hood collar connections shall have a liquid tight continuous external weld. Types of joints include the following:

1. Telescoping duct joint.
2. Bell duct joint.
3. Butt duct joint.

2.5 DUCT MOUNTED ACCESS DOOR

A. Materials
   1. Four (4) galvanized steel threaded rods, 1/4 inch diameter by 6 ½ inches long.
   2. Four (4) steel tubes, 5 inches long.
   3. Four (4) insulation pins.
   4. Access cover; same material and thickness as duct. (Dimensions as shown on plans.)
   5. Fire wrap; tape and sealant.

B. Application of grease duct mounted access doors.
   1. Cut door opening in duct per sizes shown on drawing.
   2. Weld threaded rods on four corners of door opening.
   3. Place steel tubes over threaded rods.
   4. Cut access panel to overlap access opening by 1 inch on all sides.
   5. Weld insulation pins to access panel.
   6. Cut one (1) layer of insulation (same size as panel) and impale over insulation pins.
   7. Cut an additional layer of insulation (overlap panel by 1 inch on all sides) and impale over insulation pins.
   8. All layers are impaled over welding pins and layers are locked in place with speed clips. Turn down pins to avoid sharp points.
   9. The insulated door assembly is placed over the threaded rods and held in place with washers and wing nuts.

2.6 FIRE RATED DUCT WRAP

A. Manufacturers:
   1. 3M
   2. Specialty Products and Insulation Co.

B. Insulation Materials: Fire rated fiber wrap insulation: 1 ½ inch thick low bio-persistent Alkaline Earth Silicate fiber with melting point at 2200 degrees F. Jacket shall be foil faced (one side) kraft fiber paper with a concealed reinforcing scrim. (FSK) One hour rating with 1-layer of wrap, 3 inches to combustibles. Two hour rating with 2 layers of wrap, 0 inch to combustibles.

C. Accessories and Attachments:
   1. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz. /sq. yd.
      a. Tape Width: 4 inches.
   2. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
      a. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
   3. Insulation Anchor Pins and Speed Washers: Galvanized steel plate, pin and washer manufactured for attachment to duct by weld. Pin length sufficient for insulation thickness indicated.
   4. Vapor Retarders: Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Duct construction according to the following:
   1. Range Hood Exhaust Ducts: Comply with NFPA 96.
      a. Concealed Grease laden: Carbon-steel sheet with welded joints fire wrapped.
      b. Exposed Grease laden: Carbon-steel with welded joints, fire wrapped.
      c. Concealed Dishwasher duct: 304 stainless steel with welded joints, wrapped. Reference Mechanical Insulation Specification.
      d. Exposed Dishwasher duct: 304 stainless steel No. 4 with welded joints.

3.2 EXHAUST DUCTS, INSTALLATION REQUIREMENTS

A. Install ducts to allow for thermal expansion through 2000 deg F1110 deg C temperature range.

B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal, not less than 2% slope towards hood. Where horizontal ducts exceed 75 ft. in length, the slope shall not be less than 8.3%.

C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.

D. Do not penetrate fire-rated assemblies except as permitted by applicable building codes.

E. Elbows shall be radius type with minimum centerline turning radius of 1.5 times the duct width (unless denoted otherwise on plans).

3.3 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.4 CONNECTIONS

A. Make connections to equipment with flanged, gasketed connectors according to NFPA 96.

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 TESTING

A. All ductwork under this specification to be tested per IMC “Light Test.”

END OF SECTION

SECTION 23 81 90

PRE-FAB GREASE/DISHWASHER DUCTS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ducts for conveying grease and or condensate laden and all related items. These include the following:
   1. Rectangular and round grease/condensate hood ducts.
   2. Prefabricated double-wall, round spiral-seam grease ducts and formed fittings.

1.2 SUBMITTALS

A. Shop Drawings: CAD-generated and drawn to ¼ inch equals 1 foot1:50 scale. Show fabrication and installation details for metal ducts.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Elevations of top and bottom of ducts.
   4. Dimensions of main duct runs from building grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated and other partitions.
   9. Equipment installation based on equipment being used on Project.
   10. Duct accessories, including access doors and panels.
   11. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

B. Welding certificates.

C. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.A111, "Structural Welding Code--Steel," for hangers and supports AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; (Not less than 0.054 inch (No. 16 MSG) in thickness.)

C. Stainless Steel: ASTM A 480/A 480M, Type 304 (No. 16 MSG in thickness.)

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches100 mm thick.
   2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches100 mm thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
   1. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

C. Duct Attachments:
   1. Minimum 12 gauge copper-coated steel insulation pins; galvanized steel speed clips, minimum 1-1/2 inch (38mm) square or 1-1/2 inch (38mm) diameter round, or equivalent sized insulated cup-head pins.
   2. Carbon steel or stainless steel banding material, minimum ½ inch (12.7 mm) wide, minimum 0.015 inch (0.38 mm) thick, with steel banding clips.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
   1. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
   2. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
   3. Supports for carbon-steel ducts: Carbon-steel support materials.

2.4 PREFABRICATED DOUBLE-WALL GREASE RATED DUCT.

A. Manufacturers:
   1. Metal Fab, IPIC-2 (3 inch to combustibles).
   2. Metal Fab, “No-Chase” Series 4G. (0 inch to combustibles)

B. Kitchen hood exhaust duct shall be factory prefabricated, double wall type, listed for venting of grease laden air from kitchen hoods requiring grease ducts as prescribed in NFPA 96.

C. Grease duct shall be rated for continuous operational at 500°F and intermittent operation at 2000°.

D. The inner wall shall be constructed of 0.035" thick Type 304 stainless steel. The outer wall shall be constructed of 0.025" thick aluminized steel. The annular space between the inner and outer walls shall be filled with high temperature ceramic fiber insulation.

E. All mechanical joints shall be sealed with Type P080 sealant.

F. All components of the grease duct system shall be provided by manufacturer to ensure the system meets the requirements of the listing. This includes pipe support and guides, clean-outs, expansion joints, hood/fan transitions and roof supports.

G. The grease duct shall be listed by the following agencies:
   1. UL #1978-File #MH8251
   2. ICBO
   3. SBC
   4. ASTM-E-119
   5. SBCCI PST & ESI #9666

H. The manufacturer of the grease duct shall provide assembly drawings and certify duct design in compliance with NFPA 96, Section 4-7.1.

I. The installation of the grease duct system shall be inspected and certified by the manufacturer's representative. A copy of the certification report shall be included in the close-out documents.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Duct construction according to the following:
   1. Range Hood Exhaust Ducts: Comply with NFPA 96.
      a. Concealed Grease Laden: pre-fab greaseduct.
      b. Exposed Grease Laden: pre-fab greaseduct.
      c. Concealed Dishwasher Duct: 304 Stainless steel No. 2 D finish with welded joints
      d. Exposed Dishwasher Duct: 304 Stainless steel No. 4 finish with welded joints

3.2 EXHAUST DUCTS, INSTALLATION REQUIREMENTS

A. Install ducts to allow for thermal expansion through 2000 deg F1110 deg C temperature range.

B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal, not less than 2% slope towards hood where horizontal ducts exceed 75 ft. in length the slope shall not be less than 8.3%.

C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches (38 mm) from bottom; and fit with grease-tight covers of same material as duct.

D. Do not penetrate fire-rated assemblies except as permitted by applicable building codes.

E. Elbows shall be radius type with a minimum centerline turning radius of 1.5 times the duct width.

3.3 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

3.4 CONNECTIONS

A. Make connections to equipment with flanged, gasketed connectors according to NFPA 96.

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 TESTING

A. All ductwork defined under this specification to be tested per IMC “Light Test.”

END OF SECTION

SECTION 26 00 15

GENERAL CONDITIONS FOR ALL ELECTRICAL WORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Conditions of the Contract (General and Supplementary Conditions) and Division 1 specification sections, apply to work of this section.

B. The requirements of this section apply to all sections of electrical, signal, and life safety, and all sections that are installed by the electrical contractor to include electrical work done under the mechanical contractor.

1.2 DESCRIPTION OF WORK

A. This section covers the general provisions of the electrical specifications applicable to the following systems:
   1. Electrical power.
   2. All Special Systems (fire alarm, security, telephone, data, television, and annunciators associated with power).
   3. Control wiring associated with electrical or mechanical equipment.

B. The use of the word “electrical” in any specification contained within the electrical, signal, or life safety division sections shall include all aspects of each systems complete install. This shall be extended to mechanical or plumbing signal systems.

C. The use of the word “life safety” shall refer to all fire alarm, fire protection, and mass notification systems installed by the electrical contractor.

D. The use of the word Amechanical@ shall refer to both mechanical and plumbing.

E. The use of the word Apipe@ shall refer to all electrical raceway.

1.3 DRAWINGS

A. These specifications are accompanied by drawings of the building and details of the installations showing the locations of equipment, lighting, panels, etc. The drawings and these specifications are complementary to each other, and what is called for by one shall be as binding as if called for by both.

B. Drawings and specification conflicts shall be identified as early as possible to ensure conflict resolution prior to installation. The contractor shall not install any equipment with known conflicts or pending information requests. The contractor shall contact the Engineer of Record or their representative for information clarification prior to installing any item that is in question. The contractor shall not install any equipment that is not consistent with the manufacturers approved installation instructions unless directed by the engineer.

C. In all cases all installations shall be at least in accordance with all the approved codes and their local amendments. The drawings and specifications may exceed local code allowances and the most stringent applies. The existence or allowance of a practice or product by code

does not supersede requirements of the drawings and specifications. In other words, just because it is allowed by code does not mean that it is allowed on this project.

D. If any departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Owner=s Representative for approval. No departures shall be made without prior written approval by the Owner=s Representative.

E. There are intricacies of construction which are impractical to specify or indicate in detail; however, in such cases, the current rules of good practice and applicable specifications shall govern. In all cases the requirements specified in the NEC and local jurisdiction shall be followed.

F. It is the Contractor=s responsibility to properly use all information found on the Architectural, Structural, Mechanical, and Electrical drawings and applicable shop drawings where such information affects his work. The contractor shall review the entire construction document set both prior to bid and construction.

G. All dimensional information related to new structures shall be taken from the appropriate drawings. All dimensional information relative to existing facilities shall be taken from actual measurements made by the Contractor on the site.

H. Any duplicate circuiting listed on the drawings shall be bid as multiple circuits with the intention of the next available circuit and breaker to be used. The contractor shall bring this to the attention of the engineer for clarification and updating the drawings. The new circuit numbers shall be annotated on both the panel schedules and the record drawings. The contractor is not required to follow the exact circuit numbers on the panel schedules (balancing phases, wiring convenience, or conduit routing installation), however, the contractor is responsible for keeping the panel schedules accurate and up to date in addition to ensuring the circuit numbers are identified correctly.

I. Any installation that is not in compliance with these requirements shall be corrected at the contractors cost and responsibility.

1.4 BIDDING

A. The contractor is responsible for bidding complete and working systems. In the event that some part of the system is not included in the construction document or the specifications and it is a necessary part of the system to work properly, the contractor shall include that work as part of the bid amount. This includes, but not limited to:
   1. Power for equipment shown on the drawings. Examples include, but are not limited to:
      a. Controllers
      b. Electronic Devices
      c. Mechanical Equipment
   2. Cabling to communicate with the head end equipment. Examples include, but are not limited to:
      a. Equipment starters and the switching locations
      b. Monitoring equipment

B. The contractor is not responsible for interpreting additional accessory options that are not included in the drawings or specifications or equipment that is not shown or indicated as part of the entire contract documents or specifications.

C. The contractor shall review the entire set of specifications and contract documents for all equipment and connections requiring electrical work.

D. Equipment Substitutions or Proposed Equivalents:
   1. Contractor shall submit proposed substitutions or equivalents to the Architect or engineer during the bidding process prior to any final dates for questions as indicated on the bid forms or RFP=s and provide a reasonable time to complete to comparison. All changes to the documents indicated a deviation from the specifications or drawings shall be part of the addenda process or written notification from the engineer of record, architect, owner, or a designated representative. Reasonable time for review is minimum one working week. The contractor shall retain the written notification of approval (if not published in an addenda) for purposes of future verification.
   2. The contractor is responsible for providing full comparison information for the products to be substituted. Incomplete information is subject to immediate rejection.
   3. Bids taken for equipment that is not approved is under the contractor's own risk. Should the equipment be rejected under the post bid submittal process, the contractor is responsible for providing the specified equipment at no cost to the owner.
   4. Under no circumstances should the contractor accept bids for non-specified equipment from vendors who do not have prior approval or Aspeculate@ that it will be approved. This is subject to immediate rejection and the specified equipment shall be required to be installed.
   5. No response from the architect, owner, or engineer shall not be considered an approval.

1.5 CONSTRUCTION REQUIREMENTS

A. The architectural, structural, and electrical plans and specifications and other pertinent documents issued by the Architect are a part of these specifications and the accompanying electrical drawings and shall be complied with in every respect. All the above is included in the Contract Documents and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation because architectural, structural, or mechanical details were not included in the electrical drawings.

B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.

C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to comply with Codes, to facilitate the work of other trades, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated satisfactory operating installation.

D. The mechanical, electrical, and associated drawings are necessarily diagrammatic in character and do not show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. It shall be the contractor=s responsibility to coordinate with other disciplines to facilitate their equipment installation.

E. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and above suspended ceilings, etc. in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate

hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

F. Conduit and equipment are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The plans do not show all required offsets, elbows, and other location details. Work shall be concealed in all finished areas. Conduit is intended to be installed with factory fittings or bent in a professional, workmanlike manner.

G. All parts of equipment requiring adjustment shall be easily accessible. Equipment shall be so located and installed as to permit convenient and safe maintenance and future replacement. The trade furnishing the equipment shall be responsible for notifying the Contractor, who shall notify the Owner=s Representative prior to ordering same in the event that equipment specified and/or proposed is incompatible with this requirement.

H. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability, and that he will install his work in a satisfactory and workmanlike manner which is up to the best standards of the trade, complete and in good working order. If any of the requirements of the plans and specifications are impossible of performance, or if the installation when made in accordance with such requirements will not perform satisfactorily, he shall report same to the Owner=s Representative for correction promptly after discovery of the discrepancy.

I. No extra compensation will be allowed for extra work or change caused by failure to comply with the above requirements.

1.6 JOB CONDITIONS

A. Submittal of bid implies bidder has read paragraphs of the specifications and will be bound by their conditions.

B. Contractor Qualifications: A minimum of five years' experience installing commercial electrical power lighting and special systems, similar to those described in these specifications, and make available at the owner or engineer=s request a list of five previous projects including name of project and contact person names and phone numbers as a separate document in addition to the bid or proposal submitted.

C. Contractor must be licensed and hold a current contracting license that has been valid for a minimum of five years in the local State.

D. Contractor must be able to bond work for performance of work being bid and provide a written statement from the bonding agency proposed to be used for this project as a separate document in addition to the bid or proposal submitted. The bonding agency proposed to be used shall have a Best=s insurance rating of A or A+.

1.7 INSPECTION OF THE SITE

A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil conditions, structures, utilities, equipment, systems, facilities, and local requirements. The submission of bids shall be deemed evidence of such visits. All proposals shall take these existing conditions into consideration, and the lack of specific information shall not relieve the Contractor of any responsibility.

1.8 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

A. Fees and Costs: The contractor shall obtain and pay for all permits, utility connections, utility extensions, and/or relocations and pay all costs required by the utility, including inspection fees, for all work included therein.

B. Compliance: The Contractor shall comply in every respect with all requirements of local inspection departments, Board of Fire Underwriters, local ordinances and codes, and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these specifications and drawings where specified conditions are of a higher quality than the requirements of the above-specified offices. Where requirements of the specifications and drawings are below the requirements of the above offices having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above offices.

C. Utilities: The Contractor shall check with the various utility companies involved in this project and shall provide complete in all respects the required utility relocations, extensions, modifications, and/or changes. Contractor shall verify the location of all existing utilities with the applicable Utility Company. The Contractor shall be responsible for all damages to existing utilities caused by his construction work, whether indicated on drawings or not, and repair all damage to existing utilities as acceptable to the Utility Company concerned.

D. Contractor Temporary Power: The contractor shall obtain temporary power in their name, from the local utility for the construction trailer and any equipment needed to perform his work. The contractor shall be responsible for the installation and removal of the temporary service at the conclusion of the project.

E. Certification: Prior to final acceptance, the Contractor shall furnish a certificate of acceptance from the inspection departments having jurisdiction over the work for any and all work installed under this Contract. Any additional labor costs incurred as a result of a substitution shall be the Contractor=s responsibility.

1.9 EXISTING FACILITIES

A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection, and in-service maintenance of all electrical and special systems for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work. Barricades shall clearly indicate with signage that which they are protecting. Contractor shall observe all OSHA rules.

B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, and equipment, etc. to provide this access and shall reinstall same upon completion of work in the areas affected.

D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the

Architect/Engineer all devices required for the operation of the various systems installed in the existing construction. This is to include but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, conduit, etc.

E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount. Unless otherwise scheduled by the Owner, planned shutdowns of the existing facilities shall occur between 6 p.m. Friday through 5 am Monday. The existing building shall be ready for morning start-up by 5 am Monday.

1.10 DEMOLITION AND RELOCATION

A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner and shall be delivered to such destination or otherwise disposed of as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor=s responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

1.11 SUBMITTAL DATA

A. General: As soon as practical and within 30 days after the date of award of contract and before purchasing or starting installation of any materials or equipment, the Contractor prepare or cause to be prepared shop drawings, product data, materials and equipment lists, diagrams, data, samples, and other submittals as required by the contract documents, hereinafter referred to as ASubmittal Data.@ The Contractor shall review and approve all submittal data for compliance with the contract documents, manufacturer=s

recommendations, adequacy, clearances, code compliance, safety, and coordination with associated work.

B. The Contractor shall submit approved submittal data to the Owner=s Representative for review and comment as to general conformance with the design concept and general compliance with information given in the contract documents. Owner=s Representative=s review shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with other trades or work, or construction safety and precautions, all of which are the sole responsibility of the Contractor. The reviewers shall make every effort to Acatch@ discrepancies and identify these to the contractor prior to ordering equipment. However, it shall remain the contractor's responsibility to order and install the equipment as listed in the drawings and specifications. At the owner=s representative=s discretion a detailed submittal may be required.

C. Substitutions shall be clearly identified as such in the submittal by a cover sheet indicating that items are different from what is specified or scheduled. It shall be the contractor responsibility to provide complete substitution information so an accurate comparison can be made.

D. Detail Submittals: Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of the specifications have been met and samples shall be furnished when requested. All manufacturer=s data used as part of the submittal shall have all non-applicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished. The detailed submittals shall be accompanied by the same number of sets of pictorial and descriptive data derived from the manufacturer=s catalogs and sales literature or incorporated in the shop drawings. The Contractor may provide a detailed submittal on any item even though not required by the Owner=s Representative.

E. The Engineer=s review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer=s noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.

F. The Contractor shall clearly and specifically identify and call to the attention of the Owner=s Representative any deviation from the contract documents for which Owner acceptance is desired. The responsibility for such a deviation accepted by the Owner shall remain with the Contractor.

G. Timeliness: The burden of timeliness in the complete cycle of submittal data is on the Contractor. The Contractor shall allow a minimum of four (4) weeks' time frame for the submittal cycle of each submission by the Owner=s Representative. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all re-submission cycles on non-conforming materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not justify any request for scheduled construction time extensions or extra compensation.

H. Work performed in accordance with approved submittal data that is not in accordance with the Contract Documents and did not have the specific acceptance of the Owner=s Representative shall be replaced at Contractor=s cost.

I. Submittals shall be provided in the following format:

1. The submittal brochures shall be in pdf format. The first page shall be titled AELECTRICAL SUBMITTAL INFORMATION@ and shall list the name and location of project, the Owner, the Engineer(s), the General Contractor, and the Subcontractors installing equipment represented in the brochure.
2. A table of contents will follow the first page and shall list all of the sections contained in the specification manual. Each section will be tabbed and will include its' respective brochures. All brochures will be three-hole punched and folded (if required). Each submittal section will correspond to the appropriate specification section number.
3. Provide submittal data for all materials to be used on this project as indicated in each specification manual section.
4. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.
5. Brochures: Brochures submitted to the Engineer shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space.
6. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Engineer reserves the right to require the Contractor to furnish items exactly as described in the Contract Documents.
7. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they do not meet the specifications. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner, Architect, or Engineer. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Engineer.
8. Submittal shall have the certification information as listed hereafter.
9. Shop Drawings:
    a. All shop drawings shall have the certification as listed hereafter.
    b. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: Title of the Sheet or Brochure; name and location of the building; names of the Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and Specifications showing the same work. Shop Drawings shall be prepared as follows:
        1) Shop Drawings: Drawings shall be newly prepared and not reproduced from the Contract Documents, drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by a draftsman skilled in this type of work. All equipment layouts and similar Shop Drawings shall be drawn to at least c-inch = 1'-0" scale.
        2) All Shop Drawings shall indicate the equipment actually purchased. The elevation, location, support points, load imposed on the structure at support and anchor points, shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All Design Drawing space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, etc., unless proper written authorization is required from the Engineer to change them. All associated equipment shall be coordinated and clearly shown on the Shop Drawings.

10. Submittal data for each section must be complete. Partial submittals, or submittals not in the specified format, will be rejected and returned to the Contractor without further review.

J. All equipment installed on this project shall have **local (within 125 miles)** representation, local factory-authorized service, and a local stock of repair parts. This requirement is essential and will be strictly reviewed by the Owner=s Representative prior to concurrence with the Contractor=s approval for all submittals covered by electrical division sections.

K. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of approved manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

L. These paragraphs related to electrical divisions submittal data rescind, amend, and supersede any provisions to the contrary contained in the Project Manual.

1.12 CERTIFICATION OF SUBMITTAL DATA

A. The Contractor shall provide the following certification with all submittal data furnished to the Owner=s Representative for review and comment.

Project Title:

Description of Submittal Data:

This is to certify that the above-described submittal data has been reviewed and is approved for compliance with the Contract Documents, manufacturer=s recommendation, adequacy, clearances, code compliance, safety, and coordination with other trades and/or work except as follows: (list Anone@ or itemize and explain). In addition, the Contractor shall submit to the Owner=s Representative a signed statement from each representative certifying as follows:

EXCEPTIONS:

"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer=s representative and is properly installed and operating in accordance with the manufacturer=s recommendations and are asbestos free.@

_____

Name and Company

1.13 ACCEPTANCE OF MATERIALS AND EQUIPMENT

A. Owner's Manual: After the submittals have been accepted the Contractor is requested to include a minimum of three (3) additional copies for insertion in the project=s Owner=s Manuals at the completion of the project.

B. **NOTICE: The Contractor is responsible for providing materials and equipment that conform to the requirements of the project manual in every respect unless a deviation has been Aaccepted@ in writing. Removal of any nonconforming materials and equipment and the replacement with conforming materials and equipment shall be at the Contractor=s sole expense, regardless of when nonconformance was discovered. If the owner or owner's representative elects to keep the equipment it shall be**

contractors responsibility to provide any additional connections or services required to make the equipment function as specified or required by the manufacturer. The contractor shall coordinate with other subs for any different material requirements (wire size, breakers, cooling, mounting requirements, etc.).

C. Approval of materials and equipment shall be based on manufacturer=s published data and shall be tentatively subject to the submission of complete shop drawings which comply with the contract documents. Approval is also dependent upon the existence of adequate and acceptable clearances for entry, servicing, and maintenance.

D. Approval of materials and equipment under this provision shall not be construed as authorizing any deviations from the specifications, unless the attention of the Owner=s Representative has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

1.14 SHOP DRAWINGS

A. As soon as practicable after the award of contract and approval of materials and equipment, but prior to installation, complete and detailed shop drawings of the following shall be submitted for review and comment:
   1. Equipment arrangements.
   2. Fire alarm system.
   3. Data drops.
   4. Security system.
   5. Equipment foundations.
   6. Factory-fabricated equipment and materials.
   7. Anchors.
   8. Control.
   9. Interlock.
   10. Switch gear configuration.
   11. Other details as directed by the Owners Representative. Composite drawings of areas requiring coordination between trades shall be provided and expedited to eliminate conflicts and to ensure maximum cooperation and work progress.

B. Work performed without benefit of reviewed and approved shop drawings **will not be recommended for payment by the Engineer** until such time as the shop drawings are submitted, reviewed, and approved. Any work performed without the benefit of reviewed and approved shop drawings may require removal, relocation, and/or replacement at the Contractors sole expense in order to resolve conflicts between the various systems and provide the performance specified.

C. All installation of equipment, fixtures, terminal devices, etc. shall be made in accordance with approved composite shop drawings. The Contractor shall modify installation and relocate installed work to provide code clearances, service access, and eliminate conflict with other systems.

D. Separate and submit shop drawings per building and floor. Do not combine buildings into one submittal.

1.15 SITE OBSERVATION

A. Site observation by the Architect, Engineer, and/or Owner=s Representative is for the express purpose of verifying compliance by the Contractor with the contract documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.16 SUPERVISION

A. In addition to the Superintendent required under the conditions of the contract, each subcontractor shall keep a competent superintendent or foreman on the job at all times.

B. It shall be the responsibility of each superintendent to study all plans and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and, before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the jobsite by the superintendents involved. Where interferences cannot be resolved without major changes to the plans, the matter shall be referred to the Owner=s Representative for comments.

1.17 OPERATION PRIOR TO COMPLETION

A. When any piece of electrical equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation and has the written permission of the Owner=s Representative to do so. The contractor shall energize the power distribution in a timely manner to facilitate completion of other trades work. Electrical lighting shall be energized after ceiling has been completed. New permanent fixtures shall not be used as temporary under any circumstances. The warranty period shall not commence, however, until such time as the equipment is operated for the beneficial use of the Owner or date of substantial completion, whichever occurs first.

B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and the start of the warranty may not be the same date.

1.18 MANUFACTURER'S RECOMMENDATIONS

A. The manufacturer=s published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material. The Contractor shall promptly notify the Owner=s Representative, in writing, of any conflict between the requirements of the contract documents and the manufacturer=s directions and shall obtain the Owner=s Representative=s comments before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer=s directions or applicable comments from the Owner=s Representative, he shall bear all costs arising in connection with the correction of such deficiencies.

1.19 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

A. Before final acceptance of the work, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of his materials and/or equipment to determine that it is properly installed and in proper operating order. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise. In addition, the Contractor shall submit to the Owner=s Representative a signed statement from each representative certifying as follows:

> AI certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer=s representative and is properly installed and operating in accordance with the manufacturer=s recommendations and are asbestos free.@

1.20 OPERATING AND MAINTENANCE INSTRUCTION

A. The Contractor shall prepare for the owner=s manual hereinafter specified complete sets of operating and maintenance instruction's, control and interlock diagrams, manuals, parts lists, etc. for each item of equipment. These are to be assembled as hereinafter specified for owner=s manual.

B. In addition, the Contractor shall provide the service of a competent engineer or a technician acceptable to the Owner=s Representative to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of sufficient duration to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, acknowledged by the Owner, stating the dates of instruction and personnel to whom instructions were given.

C. Additional diagrams, operating instructions, etc. shall be provided as specified hereinafter in the other sections of these specifications.

1.21 MATERIAL AND EQUIPMENT SCHEDULES

A. Contractor shall refer to both drawings and specification for schedules. Where reference is made to items Ascheduled on drawings@ or Ascheduled in specifications,@ same shall include schedules contained in both the drawings and the specifications. The Contractor=s attention is directed to the various specification sections and drawings for schedules.

1.22 APPLICABLE CODES AND STANDARDS

A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these specifications, except as may be hereinafter specifically modified in these specifications and associated drawings.
   1. National Fire Protection Association Standards (NFPA):
      a. NFPA No. 10, Portable Fire Extinguishers
      b. NFPA No. 54, National Fuel and Gas Code
      c. NFPA No. 70, National Electrical Code
      d. NFPA No. 101, Life Safety Code
      e. NFPA No. 255, Method of Test of Surface Burning Characteristics of Building Materials
   2. American National Standards Institute (ANSI):
   3. American Society of Mechanical Engineers (ASME): Section IV, V, CSD-1
   4. American Society of Testing Materials (ASTM): All applicable manuals and standards.
   5. National Electrical Manufacturers= Association (NEMA): All applicable manuals and standards.
   6. State Occupational Safety Act: All applicable safety standards.
   7. Occupational Safety and Health ACT (OSHA): National Sanitation Foundation, Standard No. 2
   8. Americans with Disabilities Act, 1990
   9. State jurisdiction Accessibility Standards
   10. American Gas Association (AGA)
   11. Underwriters Laboratories, Inc. (UL)
   12. Applicable State Building Codes (Uniform Building Codes, as amended):
   13. All County codes related to mechanical, electrical, plumbing, and system equipment; piping; conduit; wiring; etc. furnished and installed under these specifications.
   14. All City ordinances related to mechanical, electrical, plumbing, and systems and equipment; piping; conduit; wiring; etc. furnished and installed under these specifications.
   15. Refer to specification sections heretofore bound for additional codes and standards.

B. All materials and workmanship shall comply with all applicable city, state, and national codes, specifications, and industry standards. All materials shall be listed by the Underwriters Laboratories, Inc. as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.

C. The contract documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Owner=s Representative in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 1 of these contract documents, providing no work or fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules, and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.23 DEFINITIONS

A. Refer to the condition of the contract for Division 1 for additional requirements regarding definitions.

B. Where Aas required@ is used in these specifications or on the drawings, it shall mean Athat situations exist that are not necessarily described in detail or indicated that may cause the Contractor certain complications in performing the work described or indicated. These complications entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result.@

C. Where Aand/or@ is used in these specifications or on the drawings, it shall mean Athat situations exist where either one or both conditions occur or are required and shall not be interpreted to permit an option on the part of the Contractor.

D. Unless specifically indicated otherwise elsewhere in these specifications or on the drawings the word Afurnish@ or any of its derivatives shall be understood to indicate the purchase, delivery, storage and protection of an item at the job site in a location and manner suitable for use by the recipient who will be responsible for installation of this item. The word Ainstall@ or any of its derivatives shall be understood to indicate taking receipt of an item, properly mounting it, and providing the related utilities (electrical, communication, etc.) for proper and complete operation of the item. Installation shall also include calibration, programming and operational testing of said item. The word Aprovide@ or any of its derivatives shall be understood to indicate both furnishing and installing an item.

1.24 SUBSTANTIAL COMPLETION

A. Refer to Division 1 for additional requirements for substantial completion.

B. Substantial completion shall be defined as the level of project completion where the owner is ready to occupy the building. The contractor shall have ensured that all mechanical, electrical, plumbing, and building systems (elevators, automatic doors, hardware, security, etc.) are complete and in fully functional working order. This level of completion does not absolve the contractor from the requirements of final inspection or final acceptance. The contractor shall ensure there are no life safety issues unresolved with the project at the time of substantial completion.

C. All Apunch@ list items shall have been resolved or shall be identified as pending resolution. Items listed as unresolved shall be either pending information or direction from the owner or owner's representative or shall be awaiting parts or supplies that are Aon order@. The contractor at the owner's discretion shall produce documentation of the part or supply on order status.

1.25 FINAL INSPECTION

A. Refer to Division 1 for additional requirements for final inspection.

B. It shall be the responsibility of the Contractor to personally conduct a careful inspection, assuring himself that the work on the project is ready for final acceptance and developing his own Apunchlists,@ before calling upon the Owner=s Representative to make a final inspection. Failure of the Contractor to conduct such inspections and provide the Owner=s Representative with a copy of his Apunchlists@ prior to the final inspection shall be adequate cause for the Owner=s Representative to cancel any Contractor-requested final inspection.

C. In order not to delay final acceptance of the work, the Contractor shall conduct his own Afinal inspections@ prior to requesting the Owner=s Representative to Afinal@ the project; will have all necessary bonds, guarantees, receipts, affidavits, etc. called for in the various articles of this specification prepared and signed in advance; and together with a letter of transmittal listing each paper included, shall deliver the same to the Owner=s Representative at or before the time of said final inspection. The Contractor is cautioned to check over each bond, receipt, etc. before preparing same for submission to see that the terms check with the requirements of the specifications.

D. The final inspection will be made jointly by the Owner=s Representative and the Owner.

1.26 REQUIREMENTS FOR FINAL ACCEPTANCE

A. Requirements for final acceptance shall include but not be limited to the Contractor accomplishing the following:
   1. Construction: Complete all construction.
   2. Deficiency Lists: Correct all deficiencies listed at time of Substantial Completion.
   3. Owner's Manual: Submit at least 30 days prior to final acceptance one (1) copy of the owner=s manual for the Owner=s Representative=s review and comments. Following acceptance, prepare three (3) copies of bound and indexed owner=s manual, to be delivered at the time of final acceptance, which shall include but not be limited to the following:
      a. System operating instructions.
      b. System control drawings.
      c. System interlock drawings.
      d. System maintenance instructions.
      e. Manufacturers', suppliers=, and subcontractors= names, addresses, and telephone numbers, both local representatives and manufacturers= service headquarters.
      f. Equipment operating and maintenance instructions and parts lists.
      g. Manufacturers' certifications (see Checking and Testing Materials and/or Equipment, this section).
      h. Contractor's warranty.
      i. Acceptance certificates of authorities having jurisdiction.
      j. Log of all tests made during course of work.
      k. Owner's acknowledgment of receipt of instruction, enumerating items in owner=s manual.
      l. List of manufacturers= guarantees executed by the Contractor.

m. Owner’s acknowledgment of items of equipment or accessories indicated or specified to be turned over to Owner.

4. Instructions:
   a. Verbal, as herein specified.
   b. Posted, framed under glass or plastic laminated:
      1) System operating instructions.
      2) System control drawings.
      3) System interlock drawings.
5. Record Drawings: Deliver the specified record drawings to the Owner=s Representative.

1.27 RECORD DRAWINGS

A. The Contractor shall maintain a set of contract drawings at the job site on which he shall indicate the installed locations of all equipment, electrical lighting, data drops, fire alarm devices, PA system devices, security devices, outlets, and electrical feeders. These drawings shall be used for reference or construction and shall not leave the field office. Upon completion of the work, the Contractor shall obtain and pay for Mylar’s and/or disks (if available as CAD files) of the contract drawings from the Owner=s Representative and transfer the above information to these Mylar’s to provide ARecord Drawings.@ The above-mentioned prints and ARecord Drawings@ shall then be delivered to the Owner=s Representative. Refer to paragraph entitled ARecord ADrawings@ of the Supplemental General Conditions.

1.28 ALLOWANCES

A. Refer to Division 1 for allowances.

1.29 ALTERNATE PROPOSALS

A. Alternate proposals are summarized in Division 1 and on the bid proposal form. Refer to all sections of the specifications and the drawings to determine the exact extent and scope of the various alternate proposals as each pertains to the work of the various trades.

1.30 WARRANTY

A. General: All work performed (including equipment and materials furnished) under the various sections of these specifications shall be 100% warranted, for a period of one (1) year from the date of substantial completion thereof, against defective materials, design, and unauthorized substitution. Upon receipt of note of failure of any part of the guaranteed equipment and/or facilities during the guaranty period, the affected part(s) or facilities shall be replaced promptly with new parts, etc. by and at the expense of the Contractor. Further, the Contractor shall properly obtain, execute, and forward any and all manufacturer=s warranties on equipment furnished under the Contract. Refer to Division 1 for additional requirements.

B. Extended Period: The Contractor shall provide all extended time warranties available from the manufacturer of the equipment provided as standard at no additional cost. This includes all extended warranties where specified with certain equipment as directed in other sections of this Specification.

1.31 SPARE PARTS

A. Spare Parts Data: As soon as practicable after approval of materials and equipment and, if possible, not later than four months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies with current unit prices and sources of supply, a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified hereinafter to be furnished as part of the Contract, and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 120 days at the particular installation. The foregoing shall not relieve the Contractor of any responsibilities under the warranty specified.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

A. All materials, unless otherwise specified, shall be current United States manufacture, new, free from all defects, and of the best quality. Foreign goods specifically approved for use by the Owner=s Representative prior to bidding may be furnished.

B. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by electricians skilled in their respective trades, and the installations shall present a neat, precise appearance.

C. The responsibility for the furnishing and intended installation of the proper electrical equipment and/or material as intended rests entirely upon the Contract. The Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

2.2 MATERIAL AND EQUIPMENT REQUIREMENTS

A. Manufacturer's Instructions: The manufacturer=s published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Owner=s Representative in writing of any conflict between the requirements of the Contract Documents and the manufacturer=s direction and shall obtain the clarification of the Owner=s Representative before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer=s directions or such clarification by the Owner=s Representative, he shall bear all costs arising in connection with the correction of the deficiencies.

B. Storage at Site: The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage from surrounding work. All new or relocated equipment shall be stored inside or protected from the environment. Equipment that is not properly stored shall be replaced by the contractor at no cost to the owner.

C. Capacities shall be not less than those indicated and shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.

D. Conformance to Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters Laboratories, Inc., or constructed and/or tested in accordance with the standards as listed in the NEC, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such

requirements. The label of the Underwriters Laboratories, Inc. applied to the item will be acceptable as sufficient evidence that the items conform to such requirements.

E. Nameplates: Each major component of equipment shall have the manufacturer=s name, address, and model-identification number embossed on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection. All equipment starters and disconnects shall be tagged with the equipment designated mark and circuit.

F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8 inch on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified, except that coal tar or asphalt-type coatings will not be acceptable unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.

G. Protection of Connections: Switches, breaker handles, keys setscrews, handles and other parts not listed for normal occupied operation (light switches, etc.) shall be located accessible to but out of paths to prevent their accidental shutoff.

H. Verifications of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Owner=s Representative of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner, Architect, or Engineer.

I. Standard Products: Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.

2.3 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. No substitution of materials or equipment herein specified or called for on the drawings will be permitted, except by written permission of the Owner=s Representative. Where several makes of equipment or material are mentioned, any item named may be bid upon provided it meets space, capacity specifications, finish, usage (switching, ballasts, similar operation), and looks and functions as what was specified.

B. Do not submit substitutions that do not match in whole what was specified or scheduled. Deviations from scheduled or specified items are installed at the contractor’s risk and are subject to replacement if the owner/engineer deems the product different from the specified item.

C. If the specified item is no longer available, it is the contractors responsibility to contact the architect/engineer and notify that the item is not available and suggest a suitable substitution that matches in whole the form, function, and appearance of the scheduled or specified item.

D. Refer to Conditions of the Contract and Division 1 for additional requirements regarding substitutions.

2.4 FLAME SPREAD AND SMOKE DEVELOPED PROPERTIES OF MATERIALS

A. Plenum cable, conduit, insulation, equipment support and mounting hardware, tapes, adhesives, core materials, jackets, and other materials in concealed locations, including any above-ceiling area, shall have a flame spread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating no higher than 50. Flame spread and smoke developed ratings shall be in accordance with NFPA Standard No. 255.

2.5 MOTORS

A. The Contractor shall provide all motors required for equipment supplied under each portion of the work. Motors shall be built in accordance with the latest ANSI, IEE, and NEMA standards, shall be fully coordinated with the equipment served, shall be of sizes and electrical characteristics scheduled.

2.6 STARTING EQUIPMENT

A. Each motor shall be provided with proper starting equipment. This equipment, unless hereinafter specified or scheduled to the contrary, shall be provided by the trade furnishing the motor. All motor starting equipment provided by any one trade shall be of the same manufacture unless such starting equipment is an integral part of the equipment on which the motor is mounted.

2.7 SLEEVES, INSERTS, AND FASTENINGS

A. General: Proper openings through floors, masonry walls, roofs, etc. for the passage of conduits shall be provided. All conduit through floors and walls must pass through sleeves, except conduit that is cast-in-place. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Owner=s Representative.

B. Materials: Sleeves shall be of standard weight galvanized iron pipe, except heavy-gauge galvanized iron sleeves may be utilized in concrete pours where acceptable to the Owner=s Representative for size and metal gauge. Sleeves in fittings, grade beams, and where pipes enter or leave the building or pass through concrete or masonry shall be Schedule 40 PVC along the pipe route from the underground installation to the insulating coupling installed above ground.

2.8 FOUNDATIONS

A. General: All special foundations and supports required for the proper installation of equipment and pipe shall be provided as hereinafter specified and under the section of the specifications covering the equipment, unless otherwise indicated on the drawings.

B. Concrete foundations for the support of equipment such as floor-mounted transformers, switchgear, equipment, etc. shall be not less than 5 inches high and 4 inches beyond the equipment, unless otherwise noted, and shall be poured in forms built of new dressed lumber. All corners of the foundations shall be neatly chamfered by means of sheet metal or triangular wood strips nailed to the form. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Allow 1 inch

below the equipment bases for alignment and grouting. Foundations for equipment located on the exterior of the building shall be provided as indicated. Foundations shall be constructed in accordance with approved shop drawings and shall be reinforced with #4 bars at 12 inches on center both ways (minimum). Refer to Division 3: Concrete Work for materials, placement, etc. Coordinate with the equipment manufacturer for heavy (greater than 1000 pounds) pieces of equipment.

2.9 ACCESS DOORS

A. General: Provide wall, ceiling, or duct access doors for unrestricted access to all concealed items of electrical equipment.

B. Manufacturers shall be Inland-Milcor, Bilco, Miami Carey, or approved equal.

C. UL labeled when in fire-rated construction, one and one-half hour rating.

D. Equipment access doors shall be of sufficient size to remove/replace equipment and provide routine maintenance as necessary, unless otherwise noted. All doors shall have wedge-type latches except where cylinder locks are otherwise indicated or specified. Doors shall be set flush with adjacent finish surfaces. Exterior doors shall be provided with cylinder locks.

E. Access doors into ductwork shall be 14-gauge insulated galvanized steel with 16-gauge galvanized gasketed steel frame and cam-type locks. Access door shall be a minimum of 12" $\times$ 12" in size.

2.10 CONDITION OF MATERIALS

A. All materials required for the installation of the electrical systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being erected and installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

PART 3 - EXECUTION

3.1 SPACE AND EQUIPMENT ARRANGEMENTS

A. The size of electrical equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers will be acceptable, it is the responsibility of the Contractor to determine whether the equipment he proposes to furnish will fit in the space. Shop drawings shall be prepared when required by the Owner=s Representative to indicate a suitable arrangement.

B. All equipment shall be installed in a manner to permit access to all surfaces.

3.2 LARGE APPARATUS

A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

3.3 HOISTING, SCAFFOLDING, AND TRANSPORTATION

A. Provide hoisting and scaffolding facilities as required to set materials and equipment in place.

3.4 PROTECTION

A. The Contractor shall take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the uncompleted building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

B. The Contractor shall protect existing facilities, the work of others, and the premises from any and all damages that may be made possible by the execution of work.

C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these specifications.

3.5 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

A. Each trade, subcontractor, and/or Contractor must work in harmony with the various trades, subcontractors, and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

B. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the jobsite in a clean and safe condition. At the end of each day=s work, each trade shall properly store all of its tools, equipment, and materials and shall clean its debris from the job. Upon the completion of the job, each trade shall immediately remove all of its tools, equipment, any surplus materials, and all debris caused by its portion of the work.

3.6 PRECEDENCE OF MATERIALS

A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the several available spaces, and which will ensure complete and satisfactory systems. Each subcontractor and/or trade shall be responsible for the proper fitting of his material and apparatus into the building.

B. The work of the various trades shall be performed in the most direct and workmanlike manner without hindering or handicapping the work of other trades. Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade for proper operation. Where space requirements conflict, the following order or precedence shall, in general, be observed:
   1. Building lines.
   2. Structural members.
   3. Soil and drain piping.
   4. Condensate drains.
   5. Vent piping.

6. Supply, return, and outside air ductwork.
7. Exhaust ductwork.
8. HVAC water and steam piping.
9. Steam condensate piping.
10. Fire protection piping.
11. Natural gas piping.
12. Domestic water (cold and hot).
13. Refrigerant piping.
14. Electrical conduit.

3.7 CONNECTIONS FOR OTHERS

A. This Contractor shall rough-in for and make all electrical connections to all fixtures, equipment, machinery, etc. provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.

B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required conduit, fittings, whips, connectors, etc.

C. The Mechanical Contractors will set in place, ready for connection, all motors to be provided under their Contracts. The Mechanical Contractors will furnish and deliver all starter and control equipment not shown in motor control centers for any motors which they furnish. The Mechanical Contractor shall be responsible for the complete installation of all automatic temperature control systems, including wire, conduit, and interlocking connections.

D. The Electrical Contractor shall connect all motors and shall set in place all control devices, furnishing supports if and as necessary, and shall furnish and install all interconnecting line voltage wiring and make all connections ready for operation between motors, starters, and disconnect switches, as required. The Electrical Contractor shall furnish and install all motor control centers, including breakers, starters, etc. The Contractor shall refer to the Mechanical drawings and specifications for his scope of the connections to equipment furnished under these Contracts.

3.8 INSTALLATION METHODS

A. Where to Conceal: All conduits shall be concealed in chases, walls, furred spaces, below suspended floors, or above the ceilings of the building unless otherwise indicated. All concealed conduit shall be run in a professional manner, and parallel or perpendicular to the building lines.

B. Where to Expose: In mechanical rooms, only where necessary, conduit may be run exposed. All exposed conduit shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines. Conduit shall be bent in a manner as to run parallel to other conduits and not cross at angles.

C. Support: All conduit shall be adequately and properly supported from the building structure by means of hangers or clamps to walls as herein specified.

D. Maintaining Clearance: Where limited space is available above the ceilings and below concrete beams or other deep projections, conduit shall be sleeved through the projection where it crosses, rather than hung below them, in a manner to provide maximum above-floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Owner=s Representative for each penetration.

E. All conduits, etc. shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit openings shall be kept closed until the systems are closed with final connections.

F. Special Requirements:
   1. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Owner=s Representative and resolve the conflict prior to erection of any work in the area involved.
   2. All conduit not directly buried in the ground or installed outside shall be considered as Ainterior.@
   3. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the Owner=s Representative so that arrangements can be made for an inspection of the above-ceiling area about to be Asealed off.@ The Contractor shall give as much advance notice as possible up to ten (10) working days, but in no case less than five (5) working days.
   4. The purpose of this inspection is to verify the completeness and quality of the installation of the electrical systems and any other special above-ceiling systems, such as data, fire alarm, security. The ceiling supports (tee bar or lath) should be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
   5. No ceiling material shall be installed until the deficiencies listed from this inspection have been corrected to the satisfaction of the Owner=s Representative.

3.9 CUTTING AND PATCHING

A. General: Cut and patch walls, floors, etc. resulting from work in existing construction or where made necessary by failure to provide proper openings or recesses in new construction.

B. Methods of Cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Owner=s Representative. Impact-type equipment will not be used except where specifically acceptable to the Owner=s Representative. Openings in concrete for pipes, conduits, outlet boxes, etc. shall be core drilled to exact size. **Determine location of embedded conduit and reinforcing bars prior to cutting.**

C. Restoration: All openings shall be restored to Aas-new@ condition under the appropriate specification section for the materials involved, and shall match remaining surrounding materials and/or finishes.

D. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc. shall be of the proper size and shape, and shall be installed in a manner acceptable to the Owner=s Representative.

E. Plaster: All mechanical work in area containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

F. Weakening: No cutting, boring, or excavating which will weaken the structure shall be undertaken.

3.10 SLEEVES, INSERTS, AND FASTENINGS

A. Sleeves: The minimum clearance between horizontal conduit and sleeve shall be 3 inch, except that the minimum clearance shall be 2 inch where piping contacts the ground. Sleeves through floors shall extend : inch above the floor; sleeves through walls and partitions shall be installed flush with exposed surfaces. Sleeves are not required for piping indicated to the cast-in-concrete slabs-on-fill.

B. Inserts: Suitable concrete inserts for conduit and equipment hangers shall be set and properly located for all conduit and equipment to be suspended from concrete construction.

C. Fasteners: Fastening of pipes, conduits, etc. in the building shall be as follows:
   1. To wood members: by wood screws.
   2. To masonry and concrete: by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry or concrete.
   3. To steel: machine screws or welding (when specifically permitted or directed), or bolts.

D. Weatherproofing: The annular space between a conduit and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50% greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of wall or floor with a fire-resistant sealant.

3.11 FLOOR AND CEILING PLATES

A. Except as otherwise noted, provide one-piece chrome-plated brass floor and ceiling plates (or escutcheons) around all pipes, conduits, etc. passing through walls, floors, or ceilings in any spaces, except underfloor and attic spaces. Plates shall be sized to fit snugly against the outside of the conduit. Plates will not be required for piping where sleeves extend : of an inch above finish floor and are concealed. Plates shall be one piece.

3.12 FIRE AND SMOKE PARTITION, WALL, AND/OR FLOOR PENETRATIONS

A. Conduit passing through fire- or smoke-rated floors, partitions, walls, or other barriers within a UL-listed assembly which shall maintain the rating of the applicable wall, floor, partition, or barrier. Flexible conduit shall not be used in rated walls. Provide connections between Ahard@ pipe and flexible whips on either side of wall. Fireproof around conduits.

B. The Contractor shall review the architectural and structural drawings and determine the location of the fire-rated building elements. Where these elements are penetrated, UL-listed fire-rated penetration assemblies approved by the local authority shall be provided in accordance with the manufacturer=s instructions to obtain the required rating.

3.13 METAL BUILDING SYSTEMS/ELECTRICAL SUPPORTS

A. Metal building systems are required to be designed by the manufacturer to accommodate and support the electrical systems indicated on the electrical drawings and specifications.

B. The metal building systems manufacturer is required to provide the following:
   1. Framed openings through the roofs with supports, roof curbs, and flashings for roof-mounted equipment, fans, vents, and air intakes.

2. Structural support for piping, conduits, and suspended equipment consisting of beam, joists, purlins, and/or blocking above and perpendicular to conduit routes and equipment hangers at intervals not to exceed 8 feet.
3. Structural support for suspended ceilings and light fixtures, including associated raceways.

C. The electrical trade shall:
1. Provide all routes, weights, installation heights, opening locations, etc. for all equipment, conduits, sleeves, etc. to the metal building system manufacturer and coordinate requirements for structural supports, hangers, attachments, etc. with the metal building systems manufacturer.
2. Provide all supporting devices (hangers, attachments, brackets, cross beams, etc.) to attach to the metal building structural system.

3.14 CONDUIT SUPPORT

A. Conduit Support: All conduits throughout the building, both horizontal and vertical, shall be adequately supported from the construction to line of grade, with proper provision for expansion, contraction, vibration elimination, and anchorage. Vertical conduits shall be supported from floor lines with riser clamps sized to fit the lines and to adequately support their weight. At the bases of lines, where required for proper support, provide anchor base fittings or other approved supports.

B. Conduit shall not be supported from any other system.

3.15 HANGERS

A. General: Each hanger shall be properly sized to fit the supported pipe or to fit the outside of the insulation on lines where specified.

B. Attachment:
1. The load on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete which holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required.
2. Where pipes are supported under steel beams, approved-type beam clamps shall be used.
3. Where conduit is supported under wood joists, hanger rods shall be attached to joists with side beam brackets or angle clips.

C. Spacing: All hangers shall be so located as to properly support horizontal lines without appreciable sagging of these lines. All PVC shall be supported at intervals recommended by the manufacturer, or as otherwise specified or indicated.

D. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Kindorf, Elcen, or approved equal, channel-suspended on rods or pipes. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.

E. Ceiling-Mounted Devices: All lighting and devices or assemblies mounted in lay-in-type ceilings and which are supported by the ceiling grid, directly or indirectly, and which weigh in excess of 2 lbs., shall be provided with at least two 12-gauge minimum wire supports connected securely between the device or assembly and the structure, to serve as a safety support in the event of the collapse of or a disturbance in the support of the ceiling system that might cause the device or assembly to fall through the ceiling. This includes, but is not

limited to, light fixtures, J-boxes, and heavy speakers. Provide additional support as required where the weight of the device or assembly will exceed the safe limits of the wire supports.

F. Perforated strap iron or wire will not be acceptable as hanger material.

G. Miscellaneous: Provide any other special foundations, hangers, and supports indicated on the drawings, specified elsewhere herein, or required by conditions at the site. Hangers and supporting structures for suspended equipment shall be provided as required to support the load from the building structure in a manner acceptable to the Owner=s Representative.

3.16 ACCESS DOORS

A. Provide in walls, floors, and ceilings to permit access to all equipment and piping requiring service or adjustment. Examples of such equipment needing access are disconnects, actuators, contacts, and equipment needing periodic or replacement maintenance.

B. Use panels equal to Milcor Style M for masonry and drywall construction, equal to Milcor Style K for plastered masonry walls and ceilings. Stainless steel panels shall be used in ceramic tile or glazed structural tile.

C. Access doors located outside or in a moisture-laden environment (e.g., toilet room, dressing area, shower area, etc.) shall be stainless steel.

3.17 ROOF PENETRATIONS AND FLASHING

A. The contractor shall obtain from the Owner all warranty requirements for new or existing roofing systems and shall have all work on roof penetrations, curbs or equipment supports performed by a subcontractor acceptable to the Owner and the new or existing roofing system installer and manufacturer in order that all roofing system and materials warranties are preserved.

B. Pipe and conduit ducts, pitch pockets, curb bases, and flashing compatible with the roofing installation shall be provided for roof penetrations. Provide framing or other support around all openings through roof as required to preserve the structural integrity of the roof system and make the penetration weathertight.

C. Roof curbs for all roofs except standing seam metal roofs shall be provided by the equipment supplier supplying the roof-mounted equipment, etc., and such curbs shall be installed by the roofing trades. Contractor shall coordinate all roof curb requirements with all trades and the roofing trades at the earliest possible stage of the project.

D. Roof curbs for standing seam metal roofs shall be provided by the roofing trades. Curb base size, height, and type shall be coordinated with the roofing trades at the earliest possible stage of the project.

E. Flashing for pipe and conduit penetrations of standing seam metal roofs shall be provided and installed by the roofing trades.

F. See Division 7: Thermal and Moisture Protection for metal roof curbs, flashing, etc.

3.18 TESTS AND INSPECTIONS

A. Refer to conditions of the contract and Division 1 for additional requirements regarding tests and inspections.

B. General: The Contractor shall make all tests deemed necessary by the inspection departments of the authority having jurisdiction, Board of Underwriters, etc. He shall provide all equipment, materials, and labor for making such tests. Fuel and electrical energy for system operational tests following beneficial occupancy by the Owner will be paid for by the Owner.

C. Other: Additional tests specified hereinafter under the various specification sections shall be made.

D. Notification: The Owner=s Representative shall be notified at his office 36 hours prior to each test and other specifications requirements requiring action on the part of the Owner, Architect, Engineer, and/or Owner=s Representative.

E. Test Logs: All tests which the Contractor conducts shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description and extent of system tested, test conditions, test results, specified results, and any other pertinent data. Data shall be delivered to the Owner=s Representative as specified under ARequirements for Final Acceptance.

F. Inspections: In general, an inspection by the Owner=s Representative shall be required prior to closing up any work and prior to beneficial occupancy or final project completion. The closing up of work includes, but is not limited to, conduit installations prior to backfilling; electrical and fire protection work prior to placement of concrete; or closing up walls and overhead electrical and fire protection work prior to installation of the ceiling.

3.19 CLEANING AND PAINTING

A. The contractor shall at all times keep the premises free from accumulations of waste material or rubbish. Debris shall be removed from the site and from any street or alley adjacent to the site.

B. Thoroughly clean and touch up the finish on all parts of the materials and equipment. Exposed parts in equipment rooms, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out.

C. Exposed metal work which is not galvanized shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean and then painted with a suitable rust resistant primer. Exposed metal work includes work exterior to the building; exposed in mechanical or electrical equipment rooms and storage rooms; and other areas where occupants could see the work, whether normally occupied or not.

D. All other painting shall be accomplished under the Painting Section of Division 9 of the specifications.

E. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area Abroom clean@. Before final acceptance, vacuum all panels, switchboards, starters, and other electrical devices. Wipe clean all fixture lenses and reflectors, all panelboard and switchboard interior and exterior surfaces, being careful to remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

3.20 IDENTIFICATION AND LABELING

A. General: The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, disconnects, panels, etc. by marking them. All disconnects/starters/panels shall be labeled for the equipment they serve. Marks shall be the same as the drawings.

3.21 COORDINATION OF WORK

A. The light fixture grid layout as indicated on the drawings must be maintained. This Contractor shall refer to all light fixture plans and details indicated on the drawings.

B. The electrical trades shall locate all junction boxes, pull boxes, conduits, etc. to avoid interference with the diffusers, dampers, grilles, etc. The mechanical trades shall furnish to all other trades copies of approved ductwork shop drawings to assist in the coordination of the rough-in and installation of all items of work.

C. The order of space allocation priority in plan and in elevation shall be as follows.
1. 1st Light Fixtures, at Ceiling Soffit + 6"
2. 2nd Grade Plumbing Waste and Vent Systems
3. 3rd Ductwork
4. 4th Pressurized Piping Systems
5. 5th Electrical Conduit
6. 6th Ceiling Support System, where required

3.22 DISCHARGE OF WASTES FROM CONSTRUCTION SITE

A. The Contractor shall comply with all applicable provisions of local, state, and federal laws regarding the discharge of wastes into sewer and waterways. Special caution shall be exercised to prevent the discharge of wastes which contain oil, tar, asphalt, roofing compound, kerosene, gasoline, paint, mud, cement, lime, or other materials which would degrade the water quality of the receiving water course.

B. Disposal of Lamps and Ballasts: The proper disposal of all ballasts and lamps from the demolition of lighting fixtures as part of this project will be the responsibility of the Electrical Contractor. All lamps and ballasts found to contain hazardous contaminants will be removed from the site and transported to a licensed disposal facility by a contractor licensed in this field. All work shall be performed in accordance with current state and Federal rules and regulations pertaining to the processing of contaminated waste materials. A certificate of proper disposal from the licensed waste contractor shall be provided to the Engineer.

3.23 OPERATING AND MAINTENANCE MANUAL

A. The Contractor shall furnish indexed operating and maintenance manuals with complete technical data for each electrical system, piece of equipment, and material installed under this Contract.

B. The manuals shall be identified on the cover as AOperating and Maintenance Manual@ and shall list the name and location of project, the Owner, the Engineers, the General Contractor, and the Subcontractors installing equipment represented in the brochure.

C. Two (2) copies of the manual, bound in three-ring hardback binders shall be provided. One copy shall be completed and delivered to the Engineer prior to the time that system and equipment tests are performed. The second copy shall be delivered prior to final acceptance. The manual shall have a Table of Contents and shall be grouped in tabbed sections according to the specification sections. Each section shall be organized as follows:

1. Approved engineering submittals with complete performance and technical data.
2. Manufacturer’s local representative and/or distributor's name and address.
3. Manufacturer’s installation instructions and brochures.
4. Manufacturer’s operating and maintenance brochures.
5. Manufacturer’s installation wiring diagram.
6. Contractor’s field wiring diagram, if different.
7. Manufacturer’s brochure listing recommended spare parts.
8. Manufacturer’s brochure listing replacement part numbers and descriptions.

D. Provide a final section entitled, AWarranties and Guarantees@, for all equipment as well as Contractor=s warranty.

3.24 CONDITIONS OF EQUIPMENT AT FINAL ACCEPTANCE

A. At the time of acceptance, the Contractor shall have inspected all installed systems to assure the following has been completed:
   1. Fixtures are operating, and lenses and reflectors are free of dust, debris, and fingerprints.
   2. Panelboards have all conductors neatly formed, bundled, and made-up tight. Cans shall be vacuum cleaned and surfaces cleaned of stray paint, dust, grease, and fingerprints. All circuit directories to be neatly typed and in place.
   3. Wall plates and exposed switch and receptacle parts to be clean, free of paint, plaster, etc.
   4. Safety and disconnect switches and motor starters to be vacuum cleaned of debris and dust, and all surfaces free of stray paint, grease, and fingerprints.
   5. Switchgear, transformers, and system devices shall be cleaned internally and externally and have all surfaces restored to original surface conditions.
   6. Touch-up all scratched surfaces using paint matching the existing equipment paint. Where paint cannot be matched, the entire surface shall be repainted in a color and manner approved by the Engineer.

END OF SECTION

SECTION 26 00 50

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Raceways.
   2. Building wire and connectors.
   3. Supporting devices for electrical components.
   4. Electrical demolition.
   5. Cutting and patching for electrical construction.
   6. Touchup painting.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For electricity-metering equipment.

B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devised, 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.

1.6 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow:
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical service connections to components furnished by utility companies.
   1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
   2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section “Access Doors.”

E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. See Section “Raceways and Boxes.”

2.2 CONDUCTORS

A. See Section “Conductors and Cables.”

2.3 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.

D. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least one surface.
   1. Fittings and Accessories: Products of the same manufacturer as channels and angles.

2. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

E. Raceways and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

H. Expansion Anchors: Carbon-steel wedge or sleeve type.

I. Toggle Bolts: All-steel springhead type.

2.4 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

E. Mount all non-wall mounted equipment minimum of:
1. Two (2) inches off the wall for switchboards, free standing distribution boards, disconnects, panels and all other non-vibrating equipment.
2. Minimum of four (4) inches for vibrating equipment to include transformers.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components. Supports for electrical raceways, boxes, equipment, fire alarm / public address / data / special system(s) / other low-voltage enclosures, and other entities encompassing wiring or devices of any voltage shall be connected to a recognized structural element. [Note: For purposes of MEP work, ceiling grid shall **NOT** be considered a structural element unless prior written approval is given by Engineer on a case-by-cases basis.]

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install ¼-inch-diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1½ inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used for alignment, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box. Support the box and raceway from structural supports.

K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Where exterior electrical equipment is mounted on unistrut racks and the top of the mounted equipment is taller than 60" above the mounting surface, provide rear triangular support for unistrut rack angled 30 degrees connected 2/3 way up the rack and mounted to the same structure as the unistrut rack. If mounting on a roof assembly support for the rear support shall go through the roof at 90 degrees.

M. Install sleeves for cable and raceway penetrations of concrete slabs and walls. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
   1. Exception: Sleeves are not required for core-drilled penetrations where the hole is the same size as the outer conduit dimension. Tape or wrap conduit in contact with the concrete and firecaulk as required to maintain fire rating.

N. Provide x-ray scans for all penetrations through concrete floors that are post tension.

O. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
   1. Wood: Fasten with wood screws or screw-type nails.
   2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
   3. New Concrete: Concrete inserts with machine screws and bolts.
   4. Existing Concrete: Expansion bolts.
   5. Steel: Welded threaded studs or spring-tension clamps on steel.
      a. Field Welding: Comply with AWS D1.1.
   6. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
   7. Light Steel: Sheet-metal screws.
   8. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section “Firestopping.”

3.5 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.6 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.7 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
   1. Raceways.
   2. Building wire and connectors.
   3. Supporting devices for electrical components.
   4. Electrical identification.
   5. Electricity-metering components.
   6. Concrete bases.
   7. Electrical demolition.
   8. Cutting and patching for electrical construction.
   9. Touchup painting.

B. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
   1. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
   2. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
   3. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
   4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
   5. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

3.8 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
   1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
   2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
   3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.9 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 19

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Related Sections include “Control/Signal Transmission Media” for transmission media used for control and signal circuits.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field Quality-Control Test Reports: From Contractor.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, all conductors shall be listed for the application, temperature, and insulation rating to which they are intended.

2.2 CONDUCTORS AND CABLES

A. Refer to Part 3 “Conductor and Insulation Applications” Article for insulation type, cable construction, and ratings.

B. Conductor Material:
   1. Copper complying with NEMA WC-70.
   2. Solid conductors, sizes 10 and 12, uncoated copper per ASTM B3.

3. Stranded conductor, all other sizes, uncoated copper per ASTM B3, ASTM B787, and ASTM B8.

C. Conductor Insulation Types: Type THHN-THWN and complying with NEMA WC-70.
1. Rated for sunlight resistance all colors.
2. Conductors shall be color coded for voltage and phase as per NEC and any local amendments.
3. Larger conductors shall have taped color coding.
4. Size, rating, temperature, and type shall be permanently marked on conductor jacket.
5. Insulation shall be PVC, heat and moisture resistant, flame retardant compound as per UL-83 and UL-1063.
6. Jacket shall be polyamide outer nylon covering per UL-83 and UL-1063.

D. Rated for sunlight resistance all colors.

2.3 CONNECTORS

A. Wire Connectors Size 6-14 AWG:
1. Description: Factory-fabricated UL listed connected and of size, ampacity rating, material, type, and class for application and service indicated.
2. Provide self-locking square wire spring grab screw on wire connectors sized as per NEC and the number of conductors to be connected.
3. Thermoplastic deep shell design, with wings on smaller connectors, rated for application temperature, Minimum 105 degrees C.
4. Copper to copper connection, 600V.
5. Provide high temp wire connectors for all high temperature equipment applications.

B. Push-in wire connectors are **Not Approved** and shall not be used for any power or lighting circuits above 50V.

C. Pre-Insulated Multi-Conductor Connectors Dry Location for conductors larger than #6.
1. UL Listed rated for 90 degree C, insulated with high dialectric plastisol or equal, UV resistance, Polaris, NSI, or equal.
2. Dual rating for copper and/or aluminum.
3. Provide correct type based upon wire stranding (fine or coarse).
4. Supplied with removable plugs.

D. Pre-Insulated Multi-Conductor Connectors Wet or submersible Dry Location for conductors larger than #6.
1. UL Listed rated for 90 degree C, insulated with 125 mils rubber or equal, UV resistance, Polaris, NSI, or equal.
2. Dual rating for copper and/or aluminum.
3. Provide correct type based upon wire stranding (fine or coarse).
4. Supplied with removable plugs.

E. Pre-insulated single conductor in-line connector for conductors larger than #6 Dry Location.
1. UL Listed rated for 90 degree C, insulated with high dialectric plastisol or equal, UV resistance, Polaris, NSI or equal.
2. Dual rating for copper and/or aluminum.
3. Provide correct type based upon wire stranding (fine or coarse).
4. Supplied with removable plugs.

2.4 ALTERNATES

A. Blue Jacketed steel MC Cable is only permitted for 6 foot (maximum) lighting whips. It shall be used for **no** other purpose.

B. AC cable is **not** permitted at all.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Exposed Feeders: Type THHN-THWN, suitable for use in air return plenums.

B. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

G. Fire Alarm Circuits: Power-limited, fire-protective, signaling circuit cable.

H. Class 1 Control Circuits: Type THHN-THWN, in raceway.

I. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Minimum line voltage conductor size is #12.

C. Neutrals shall not be shared on any single pole circuit.

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. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

F. Install without damaging conductors/cable, shield, or jacket.
   1. Do not bend conductors/cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.
   2. All new installation cabling shall be one piece without breaks or splices except at device connections.

G. Conductor/Cable extensions if indicated: Provide splices and connectors suitable for the environment and conductors. Each conductor to be individually extended using either pre-insulated in-line connectors or hydraulically crimped butt connectors with 3m Scotchcast™ resin kits to complete the insulation. Connector and insulation shall be suitable for environment. All splice and tap connectors shall be compatible with cable material. Make no splices except at indicated splice points.

H. Conductor/Cable splits: Provide multi-conductor pre-insulated connectors suitable for environment with specific number of connectors to split. Provide with wireway or pull box for access. Torque to manufacturers specific requirements. Provide configuration per connections. For service wireways, provide with in-tap-out for future use.

I. Pull conductors/cables without exceeding manufacturer's recommended pulling tensions.
   1. Pull simultaneously if more than one is being installed in same raceway.
   2. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
   3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage media or raceway.

J. Provide pull boxes as per NEC.

K. Provide junction or pull boxes at all splice points.

L. Support cables according to Section “Basic Electrical Materials and Methods.”

M. Seal around cables penetrating fire-rated elements according to Section “Firestopping.”

N. Identify and color-code conductors and cables according to Section “Electrical Identification” and adhere to local color code requirements.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
   1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
   2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For firms and persons specified in “Quality Assurance” Article.

C. Field Test Reports: Submit written test reports to include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   1. Comply with UL 467.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grounding Conductors, Cables, Connectors, and Rods:

a. Apache Grounding/Erico Inc.
b. Boggs, Inc.
c. Chance/Hubbell.
d. Copperweld Corp.
e. Dossert Corp.
f. Erico Inc.; Electrical Products Group.
g. Framatome Connectors/Burndy Electrical.
h. Galvan Industries, Inc.
i. Harger Lightning Protection, Inc.
j. Hastings Fiber Glass Products, Inc.
k. Heary Brothers Lightning Protection, Co.
l. Ideal Industries, Inc.
m. ILSCO.
n. Kearney/Cooper Power Systems.
o. Korns: C.C. Korns Co.; Division of Robroy Industries.
p. Lightning Master Corp.
q. Lyncole XIT Grounding.
r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
s. Raco, Inc.; Division of Hubbell.
t. Robbins Lightning, Inc.
u. Salisbury: W.H. Salisbury & Co.
v. Superior Grounding Systems, Inc.
w. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Section “Conductors and Cables.”

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer’s written instructions.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.
C. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

D. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

C. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer’s written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturers published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
   1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
   3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
      a. Equipment Rated 500 kVA and Less: 10 ohms.
      b. Equipment Rated 500 to 1000 kVA: 5 ohms.
      c. Equipment Rated More Than 1000 kVA: 3 ohms.
      d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
      e. Manhole Grounds: 10 ohms.

   4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:
   1. Section ABasic Electrical Materials and Methods@ for supports, anchors, and identification products.
   2. Section AWiring Devices@ for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. LFNC: Liquidtight flexible nonmetallic conduit.

G. RNC: Rigid nonmetallic conduit.

H. PVC-GRS: PVC-Coated galvanized rigid steel.

1.4 SUBMITTALS

A. Product Data:
   1. For surface raceways, wireways and fittings.
   2. Floor boxes.
   3. Hinged-cover enclosures and cabinets.
   4. Conduit spacers.
   5. Conduit rack supports.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   2. Refer to 3.1, RACEWAY APPLICATION, for materials to be used.

2.2 METAL CONDUIT AND TUBING

A. Available Manufacturers:
   1. AFC Cable Systems, Inc.
   2. Alflex, Inc.
   3. Anamet Electrical, Inc.; Anaconda Metal Hose.
   4. Electri-Flex Co.
   5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
   6. Republic Conduit.
   7. Manhattan/CDT/Cole-Flex.
   8. O-Z Gedney; Unit of General Signal.
   9. Wheatland Tube Co.
   10. Perma-Cote
   11. Plasti Bond
   12. KorKap

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC--Coated Steel Conduit and Fittings: UL514b NEMA RN 1.

E. PVC- Coated IMC and Fittings: ETL PVC-001 NEMA RN 1 UL6.

F. EMT: ANSI C80.3.

G. FMC: Zinc-coated steel. Non UL listed FMC is not allowed for any line voltage (greater than 70V) system.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings: NEMA FB 1; compatible with conduit and tubing materials. Provide fittings factory matched with conduit types.
   1. Indoor Fittings: Steel Set Screw or Steel Compression
   2. Outdoor Fittings: Threaded fittings on IMC or Rigid Conduit
   3. Outdoor Fittings: Compression fittings with gaskets on all transitions to flexible conduit.
   4. Die cast fittings are not acceptable anywhere.
   5. Provide factory fittings with MC cable where allowed.
   6. EMT crimp type fittings are not acceptable.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers:
   1. American International.
   2. Anamet Electrical, Inc.; Anaconda Metal Hose.
   3. Amco Corp.
   4. Cantex, Inc.
   5. Certainteed Corp.; Pipe & Plastics Group.
   6. Condux International.
   7. ElecSYS, Inc.
   8. Electri-Flex Co.
   9. Lamson & Sessions; Carlon Electrical Products.
   10. Manhattan/CDT/Cole-Flex.
   11. RACO; Division of Hubbell, Inc.
   12. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. LFNC: UL 1660.

E. Fittings: NEMA TC 3; match to conduit or tubing type and material. Provide fittings factory matched with conduit types.
   1. Indoor/Outdoor Fittings: Compression.
   2. Outdoor Fittings: Compression fittings with gaskets on all transitions to flexible conduit.

2.4 METAL WIREWAYS

A. Available Manufacturers:
   1. Hoffman.
   2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Hinged type, or as indicated.

F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

A. Available Manufacturers:
   1. Hoffman.
   2. Lamson & Sessions; Carlon Electrical Products.

B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

2.6 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
   1. Available Manufacturers:
      a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
      b. Thomas & Betts Corporation.
      c. Walker Systems, Inc.; Wiremold Company (The).
      d. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
   1. Available Manufacturers:
      a. Butler Manufacturing Co.; Walker Division.
      b. Enduro Composite Systems.
      c. Hubbell, Inc.; Wiring Device Division.
      d. Lamson & Sessions; Carlon Electrical Products.
      e. Panduit Corp.
      f. Walker Systems, Inc.; Wiremold Company (The).
      g. Wiremold Company (The); Electrical Sales Division.

C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

D. Provide raceway base, cover, base coupling, coupling covers, angle fittings, end caps at ends, and entrance end fittings. Provide divider wall throughout raceway. Provide device brackets and snap-on bezels at all devices shown on drawings. Provide blank covers at all non-used bezels.

E. Provide raceway full length, mounted as per drawings or 6" above counters if height is not indicated, as shown on drawings. Provide elbows and raceway to 6 inches above ceiling if risers are indicated on the drawings.

2.7 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. Emerson/General Signal; Appleton Electric Company.
   3. Erickson Electrical Equipment Co.
   4. Hoffman.
   5. Hubbell, Inc.; Killark Electric Manufacturing Co.
   6. O-Z/ Gedney; Unit of General Signal.
   7. RACO; Division of Hubbell, Inc.
   8. Stahlin
   9. Scott Fetzer Co.; Adalet-PLM Division.
   10. Spring City Electrical Manufacturing Co.
   11. Thomas & Betts Corporation.
   12. Walker Systems, Inc.; Wiremold Company (The).
   13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.8 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

B. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:
   1. Exposed: Rigid steel or IMC.
   2. Concealed: Rigid steel or IMC.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
   4. Boxes and Enclosures: NEMA 250, Type 3R.

5. Penetrations though exterior walls: RMC or IMC

B. Indoors:
   1. Exposed in Mechanical/Electrical/Unfinished Spaces: EMT.
   2. Exposed in Finished Spaces: Metal Surface Raceway painted/finished to match space finishes.
   3. Concealed: EMT.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFNC in damp or wet locations or with water equipment.
   5. Damp or Wet Locations: Sealed EMT with sealed fittings.
   6. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
      a. Damp or Wet Locations: NEMA 250, Type 4, nonmetallic.

C. Minimum Raceway Size: 1/2-inch for single 20A or less circuits; otherwise, 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating using the manufacturer's PVC touch up compound after installing conduits.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz.

F. Aluminum conduit will not be accepted on this project.

3.2 INSTALLATION

A. Conduit Routing:
   1. All branch circuit conduit shall be run overhead unless specifically directed by the engineer.
      a. Exceptions:
         1) Conduit to floor boxes.
         2) Conduit to locations otherwise inaccessible overhead (exposed or not).
         3) Conduit to exterior slab locations without overhead cover.
         4) Conduit to column mounted lighting, devices, or equipment inaccessible from above.
   2. Panel feeder conduits may be run in the floor or underfloor ONLY IF indicated on the drawings or directed by the engineer.
   3. Service secondary conduits may be run underfloor or in-ground.
   4. Conduit for exterior equipment or lighting may be run underfloor or in-ground.
   5. All conduit serving any equipment or devices (to include panels, transformers, and switchboards, or any other electrical distribution equipment) within the perimeter of the building shall be run within the perimeter of the building. Conduit shall not run across courtyards or underground from one section of the building to another section of the contiguous building.
      a. Exception: Service entrance conduit.
   6. All conduit shall be run at right angles or parallel to the building lines to the limits that the structure will allow. Raceways shall not be run diagonal or curved.

B. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit

C. 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.

D. Install raceways as high as possible and coordinate installation with other equipment.

E. Install raceways to equipment mounted on the floor away from walls from overhead down to the equipment or disconnects. Do not run across the floor creating a tripping hazard. Rack support conduit at the disconnect.

F. Provide clear access to all pull and j-boxes. Provide access doors over hard (non-lay-in ceilings) to all pull boxes. Minimum access required 1.5x (times) box cover size or 18 inches.

G. Label all j-box and pull box covers with circuits contained within box.

H. Under no circumstances shall power and data or any signal below 50V be shared in the same raceway, tray, channel, or sleeve.

I. Install raceways for power conductors (any conductor over 50V) 12 inches from any signal/communications conductor (data, fiber optics, telephone, fire alarm, PA, community antenna and radio distribution (CATV), low power or network powered broadband communications, systems controls, and any other system operating under 50V) not in conduit on J-hooks.

J. Install raceways for power conductors (any conductor over 50V) 12 inches from communications raceways. Communications raceways include; data, fiber optics, telephone, fire alarm, PA, community antenna and radio distribution (CATV), low power or network powered broadband communications, systems controls, and any other system operating under 50V.
   1. Exception: Data and power raceways shall be permitted to be 2 inches apart only at the wall drop to the devices. Above the ceiling or overhead the minimum 12 inch spacing shall be maintained.
   2. Exception: Listed dual channel power poles
   3. Exception: Within the surface raceways. When not within the surface raceway, the power and communications raceways shall be 12 inches apart.
   4. Underground: Data and power conduit/raceway shall be allowed in the same trench only if specifically allowed by the engineer and then there shall be a minimum of 12 inches of fill between the power and communications raceways. Magnetic marking tape shall be placed above the level of the highest (closest to grade) raceway.

K. Exterior Exposed Raceways:
   1. See application schedule for raceway types.
   2. Provide non-flexible raceways through roofs to disconnects, panels, or receptacles as per application schedule.
   3. Provide transitions from non-flexible raceways to flexible raceways within 3 feet of the equipment.
      a. Exception: Flexible raceways may exceed 3 feet only to accommodate the drip legs.
   4. Penetrate roofing membranes with approved methods only for the type of roof used. See roofing or architectural details.
   5. Provide chem-curbs on built-up roofs unless otherwise directed from roofing or architectural details.
   6. Support all exposed raceway on roofs with manufactured neoprene blocks with integral galvanized channel, conduit hangers as part of a manufactured assembly with galvanized channel (portable pipe hangers or equal), or approved method as per architectural.

7. Exposed raceways on roofs shall not be unsupported in any areas nor attached directly to the roof.
8. Provide drip legs for all exterior exposed raceways from disconnects to equipment.

L. Complete raceway installation before starting conductor installation.

M. Support raceways as specified in Section ABasic Electrical Materials and Methods.@

N. Install temporary closures to prevent foreign matter from entering raceways during construction. Remove prior to completion of conduit.

O. Sleeves: Provide metallic raceway sleeves through walls or floors for all conductors/cabling not in raceways. Provide bushings at both ends of sleeves prior to installing any conductors or wiring. Firestop as per opening fire rating requirements.

P. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

Q. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

R. Firestop: Firestop all raceway penetrations in rated walls. Provide intumescent fill in all sleeve openings. Contractor shall be responsible for all wall repair and damage. Excessive firestop for holes too large (2 inch beyond the edge of the raceway) is unacceptable. Holes shall be repaired with suitable wall materials to maintain the integrity of the wall construction.

S. Cut openings in walls as per the outer edges of the raceway. Openings made with hammers or other wall damaging tools are not acceptable. Holes too large (2 inch beyond the edge of the raceway) are unacceptable and shall be repaired with suitable wall materials to maintain the integrity of the wall construction. Contractor shall be responsible for repair to match existing.

T. Provide manufactured elbows of conduit type specified for PVC raceways. Field constructed elbows are not allowed. Rigid Non-metallic tubing shall not have any field fabricated 90 degree bends. Provide manufactured elbows at all 90 degree changes in direction.

U. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

V. Expansion Joints: Provide flexible connections suitable for use with conduit type for all conduit in structural expansion joints or independent slabs that are within another structural assembly.

W. Install ALL exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
3. Install conduit as high as possible.
4. Flexible cable or raceway for general circuiting is allowed exposed in mechanical or electrical spaces only. Not allowed in finished spaces.
    a. Exception: As equipment connection only.

X. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

Y. Tighten set screws of threadless fittings with suitable tools.

Z. Terminations:
1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

AA. Install pull tape/wires in empty raceways.
1. For raceways under 2 inches and under less than 100 feet, 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.
2. Raceways under 2 inches and over 100 feet without intermediate pull boxes, provide mule tape. With intermediate pull boxes use pull wire.
3. For raceways over 2 inches and use mule tape.
4. Sleeves under 36 inches do not require pull tape/wire.

BB. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

CC. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Label boxes Aseal-off@. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

DD. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures if not using MC Cable for lighting whips; for equipment subject to vibration, noise transmission, or movement, and for all motors indoors of non-water operating equipment. Use LFNC in damp or wet locations or to any water operating equipment. Install separate ground conductor across flexible connections.

EE. Prime and Paint exposed conduit in finished spaces, unless pre-painted surface raceways is provided, as per owner/architect. Provide with paintable surface.

FF. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

GG. Cap all un-used/spare conduits. Does not include sleeves.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
3. Provide cover over conduits during storage to prevent dirt and debris from entering conduits during storage.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

B. Remove debris from conduits prior to capping any spare conduits.

C. Blow-out empty conduits that are future spares in any exterior or underground installation prior to capping.

3.5 RECORD

A. Record the location of all spare conduits buried for future use by the owner.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate color, lettering style, and graphic features of identification products.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAYS AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
   1. Color: Black letters on orange field.
   2. Legend: Indicates voltage and service.

B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.

C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.

H. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.

I. Brass or Aluminum Tags: 2×2×0.05-inch metal tags with stamped legend, punched for fastener.

2.2 NAMEPLATES AND SIGNS

A. Safety signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. ¼-inch grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. ¼-inch grommets in corners for mounting.

E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength: 50 lb minimum.
   3. Temperature Range: Minus 40 to plus 185 deg F.
   4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.
   1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
   2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
   3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.

4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Install painted identification according to manufacturer's written instructions and as follows:
   1. Clean surfaces of dust, loose material, and oily films before painting.
   2. Prime surfaces using type of primer specified for surface.
   3. Apply one intermediate and one finish coat of enamel.

F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
   1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
   2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
   3. Apply the following colors to the systems listed below:
      a. Fire Alarm System: Red.
      b. Fire-Suppression Supervisory and Control System: Red and yellow.
      c. Combined Fire Alarm and Security System: Red and blue.
      d. Security System: Blue and yellow.
      e. Mechanical and Electrical Supervisory System: Green and blue.
      f. Telecommunication System: Green and yellow.

G. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

H. Circuit Identification Labels on Boxes: Install labels externally.
   1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
   2. Concealed Boxes: Plasticized card-stock tags.
   3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
   4. Normal Power Circuits: Black lettering and numbers
   5. Emergency Power Circuits: Red lettering and numbers

I. Color-Coding of Secondary Branch Circuit Conductors: Use the following colors for service, feeder, and branch-circuit branch circuit conductors:
   1. 120/208V 3 Phase Conductors:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White.
e. Ground: Green.

2. 120/240V 3 Phase Conductors:
   a. Phase A: Black.
   b. Phase B: Orange (High Leg Only).
   c. Phase C: Blue.
   d. Neutral: White.
   e. Ground: Green.
3. 120/240V Single Phase Conductors:
   a. Phase A: Black.
   b. Phase B: Red or Blue.
   c. Neutral: White.
   d. Ground: Green.
4. 277/480V 3 Phase Conductors:
   a. Phase A: Purple.
   b. Phase B: Brown.
   c. Phase C: Yellow.
   d. Neutral: Gray.
   e. Ground: Green.
5. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
   a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
   b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

J. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
   1. Legend: ¼-inch- steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
   2. Tag Fasteners: Nylon cable ties.
   3. Band Fasteners: Integral ears.

K. Apply identification to conductors as follows:
   1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
   2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
   3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

L. Apply warning, caution, and instruction signs as follows:
   1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed

for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

M. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with ½-inch- high lettering on 1½-inch-high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Electrical switchgear and switchboards.
4. Electrical substations.
5. Emergency system boxes and enclosures.
6. Motor-control centers.
7. Disconnect switches.
8. Enclosed circuit breakers.
9. Motor starters.
10. Push-button stations.
11. Power transfer equipment.
12. Contactors.
13. Remote-controlled switches.
14. Dimmers.
15. Control devices.
16. Transformers.
17. Inverters.
18. Rectifiers.
19. Frequency converters.
20. Battery racks.
21. Power-generating units.
22. Telephone switching equipment.
23. Clock/program master equipment.
24. Call system master station.
25. TV/audio-monitoring master station.
26. Fire alarm master station or control panel.
27. Security-monitoring master station or control panel.

END OF SECTION

SECTION 26 12 10

CONTROL/SIGNAL TRANSMISSION MEDIA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following types of control and signal transmission media: Twisted-pair cable used for security, access control, building management systems, sound, intercom, or any Non-IT/Voice/Data Control.

B. Related Sections include the following:
   1. Section “Basic Electrical Materials and Methods” for building wire used for control or signal circuits.
   2. Section “Conductors and Cables” for building wire.
   3. Section “Raceways and Boxes.”

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

1.4 SUBMITTALS

A. Product Data: For control/signal transmission media.

B. Product Certificates: Signed by manufacturers of transmission media certifying that the products furnished comply with requirements and that they have been coordinated with and accepted by manufacturer of connected equipment.

C. Qualification Data: For firms and persons specified in “Quality Assurance” Article.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

E. Maintenance Data: For transmission media to include in the maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain all cable of each type through one source from a single manufacturer.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
   1. The Terms “Listed” and “Labeled”: As defined in NFPA 70, Article 100.

C. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect at least two (2) days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.

1.7 COORDINATION

A. Coordinate with and obtain review of cable characteristics and certification for use with the connected system equipment by the connected equipment manufacturers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Electronic Cables:
      a. American Insulated Wire Corp.
      b. AT&T Technology, Inc.; Cable and Wire Division.
      c. Berk-Tek, Inc.
      d. BICC Brand-Rex Company.
      e. Cooper Industries; Belden Division.
      f. Guardian Products; General Cable.
      g. Mohawk Wire and Cable Corp.
      h. Pirelli Cable Corp.; Power Cable Division.

2.2 ELECTRONIC CABLE

A. Provide cabling as indicated per manufacturer’s installation instructions and as indicated below.

B. Twisted-Pair Plenum:
   1. Quantity of twisted pairs indicated;
   2. No. 24 AWG, 7-strand, tinned-copper conductors; PTFE insulation; overall aluminum/polyester shield; No. 22 AWG tinned-copper drain wire; PTFE jacket; suitable for use in air-handling spaces.

C. Control cabling. Provide cabling as indicated by manufacturer. Minimum Cat 5e. Cabling shall be:
   1. Plenum rated.
   2. Color coded per drawings or specifications. Cabling shall not be the same color as data or telephone cabling.
   3. Copper Cable:
      a. Conductors are twisted in pairs with four pairs contained in a flame retardant PVC jacket separated by a spline.
      b. Superior performance exceeds all TIA/EIA-568-B Category 5 and ISO 11801 Edition 2.0 for Class E cable requirements. ETL tested and verified for Category 5E component performance.
      c. Performance tested to 500 MHz.
      d. Plenum (CMP) flame rated.

D. Cable shall be rated for indoor and outdoor use if located outside the building conditioned space. (Underfloor or buried is outside conditioned space)

E. Control cabinet data cabling. Provide cabling as indicated by manufacturer or minimum cat 5e between control cabinets and devices within cabinet.
   1. Plenum rated.
   2. Color-coded per drawings or specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine raceways and other elements to receive cables for compliance with requirements for installation tolerances and other conditions affecting performance of transmission media. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cable as indicated, according to manufacturer's written instructions.

B. Install transmission media without damaging conductors, shield, or jacket.
   1. Do not bend cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.
   2. All new installation cabling shall be one piece without breaks or splices except at device connections.
   3. Existing cabling extended or relocated from an existing point shall be spliced per manufacturer installation instructions. If there are no manufacturers splicing instructions, provide compression butt splices and plenum rated sleeves suitable for use with the cabling jacket.
      a. Use splice and tap connectors compatible with cable material.
      b. Make no splices except at indicated splice points.

C. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
   1. Pull cables simultaneously if more than one is being installed in same raceway.
   2. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
   3. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage media or raceway.
   4. Provide pull boxes as per NEC.
   5. Provide junction or pull boxes at all splice points.

D. Install exposed cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

E. Support cables according to Section “Basic Electrical Materials and Methods.”

F. Seal around cables penetrating fire-rated elements according to Section “Firestopping.”

G. Bond shields and drain conductors to ground at only one point in each circuit.

H. Connect components to wiring system and to ground as indicated and instructed by manufacturer.

I. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

J. Identify cables according to Section “Electrical Identification.”

K. Provide 24" service loops coiled every 100'. Velcro strap cabling together. Do not damage cabling by overtightening ties. If the cabling is deformed, replace the cable.

L. Mount on J-hooks when not in conduit independent of other systems. Secure to J-hooks with zip ties. Provide conduit or J-hooks separate from tele/data or security cabling. Do not tie to ceiling supports or any other non-structural support above ceiling.

M. Install in conduit in all exposed or non-continuous ceilings or any finished space where cabling is visible and all unfinished areas below 10' AFF. See Raceways and Boxes application schedule for conduit types.

N. Coordinate with owner for connector equipment type.

3.3 FIELD QUALITY CONTROL

A. Copper Cable Testing Procedures: Inspect for physical damage and test cable for continuity and shorts. Use time-domain reflectometer with strip-chart recording capability and anomaly resolution to within 12 inches in runs up to 1000 feet in length. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.

B. Replace malfunctioning cables at Project site, where possible, and retest to demonstrate compliance.

C. Provide written documentation to the owner’s representative of cabling performance.

END OF SECTION

SECTION 26 13 10

PULL AND JUNCTION BOXES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work covered by this Section includes furnishing of and paying for all materials, labor, services, equipment, licenses, taxes, other items, and appliances necessary for the execution, installation and completion of all work specified herein and/or shown on the drawings.

B. Pull and junction boxes of appropriate size and depth as indicated on the drawings and as specified hereinafter.

1.2 SUBMITTALS

A. Submittals for products furnished under this section are not required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For interior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, ¾-inch flanges, screw covers, etc.

B. For exterior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, ¾-inch flanges, bolted covers with full gaskets forming a completely raintight assembly for above ground installations. Provide concrete boxes with screw fittings and drains for in ground pull boxes. Boxes shall be sized as per NEC or as indicated on the drawings.

C. See drawings for pull boxes requiring racks.

D. Boxes with concentric knockouts are not acceptable.

E. Provide ground terminal strip and ground pull box and circuits.

F. As shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide junction boxes as shown on drawings and otherwise where required, sized according to number of conductors in box or type of service to be provided. Minimum junction box size 4 inches square and 2⅛ inches deep. Provide screw covers for junction boxes.

B. Use minimum 16-gauge steel for pull boxes and provide with screw cover.

C. Install boxes in conduit runs wherever necessary to avoid too long runs or too many bends. Do not exceed 100-foot runs without pull boxes.

D. Rigidly secure boxes to walls or ceilings. Conduit runs will not be considered adequate support.

E. Install boxes with covers in accessible locations.

F. Pull boxes, wireways or gutters above panelboards, switchboards, distribution boards, or any other circuit distributing panel shall not be wider than 1.5x (times) the width of the panel or panels if adjoining.

G. Under no circumstances shall wireways, pull boxes, or gutters wrap the room and be used as a channel for circuits, unless specifically called out by the engineer or per manufacturers shop drawings.

H. Observe maximum conductor fill as required by the National Electrical Code.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

A. GFCI/GFI: Ground-fault circuit interrupter.

B. SPD: Surge protective device.

1.4 SUBMITTALS

A. Product Data: For each product specified.

B. Shop Drawings: Legends for receptacles and switch plates.

C. Samples: For devices and device plates for color selection and evaluation of technical features.

D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NEMA WD 1.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
   1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
   1. Telephone/Power Service Poles: One for each 10, but not less than one.
   2. Floor Service-Outlet Assemblies: One for each 10, but not less than one.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Wiring Devices:
      a. Bryant Electric, Inc.
      b. Eaton.
      c. Hubbell, Inc.; Wiring Devices Div.
      d. Killark Electric Manufacturing Co.
      e. Leviton Manufacturing Co., Inc.
      f. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 SWITCHES

A. Snap Switches: Commercial spec grade.

2.3 WALL PLATES

A. Single and combination types match corresponding wiring devices. CSA certified and UL listed.
   1. Plate-Securing Screws: Metal with head color to match plate finish. Color by Architect.
   2. Material: 302 brushed stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies straight, plumb and secure. Do not overtighten to deform faceplate. Adjust receptacle depth so faceplate mounts flush with wall. Adjust receptacle to extend equilaterally 1/8” beyond the faceplate opening.

B. Install devices as per ADA height requirements.

C. Install wall plates when painting is complete. Remove all paint from any wall plates.

3.2 IDENTIFICATION

A. Comply with Section AElectrical Identification.@
   1. Switches: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

B. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

B. Replace damaged or defective components.

3.5 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION