SPECIFICATIONS

UAS ADD UTILITIES and ELECTRICAL SERVICES Bldg 516 & REPAIR Bldg 516

JFSD 200976A & B

Aug 2022 v2 (version 2)
Revision on Page 2
** Indicates Revised Line

BUILDING 516
UAS (RQ-4) ADD UTILITIES AND ELECTRIC SERVICES
(MC) & UAS (RQ-4) REPAIR B516 (R/M)

JFSD 200976A & B

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UAS Add Utilities & Electrical Services / Repair Building 516

Technical Provisions

Section 01000

1. SCOPE OF WORK:

1.1. Work to Be Done: The work consists of furnishing all plant, labor and materials to perform all work in strict accordance with these technical provisions and the project drawings.

1.2. Location: The site of the work is Grand Forks Air Force Base, ND.

2. PROJECT DESCRIPTION: The work to be performed includes, but is not limited to, the following:

2.1 Interior renovation of a portion of Building 516 and the addition of an exterior emergency generator and prefabricated enclosure with associated fuel tank to increase the reliability and durability of the base-wide telecommunications system infrastructure.

2.2. All work not specifically addressed in this specification shall be installed in strict accordance with the latest publications of the National Electric Code, Uniform Building Code, Uniform Mechanical Code, Uniform Plumbing Code, NFPA 101 Life Safety Code, and Grand Forks AFB Architectural Compatibility Guide. The GFAFB Architectural Compatibility Guide is not included in these specifications, but will be provided upon request.

2.3. International Conference of Building Officials has established the basic building code standards for construction, renovation, repair, and maintenance. These standards, commonly referred to as the International Building Code (IBC), together with the Unified Facilities Criteria UFC 1-200-01 found at http://www.wbdg.org/ccb/DOD/UFC/ufc_1_200_01.pdf shall constitute the minimum acceptable levels of construction, function, and safety for all projects.

2.4. All material selections, construction, renovation, repair, and maintenance shall comply with the latest addition of Unified Facilities Criteria UFC 3-600-1 Fire Protection Engineering for Facilities.

3. STANDARD TESTS, QUALITY, AND GUARANTEES:

3.1. Tests or trials to determine the effectiveness of performance of a completed assembly or fabricated system shall be made by the contractor.

3.2. All articles, supplies and equipment, parts, and assemblies thereof, of standard manufacturers or for which design requirements are not prescribed by these specifications shall be guaranteed against any failure in the proper use or operation caused by defective material, workmanship, or design for the full warranty time which is standard with the manufacturer and/or supplier.

3.3. The contractor shall provide a minimum one year warranty on all work performed. A copy of the warranty shall be submitted to the Contracting Officer before final inspection of the facility.

4. WORK CLEARANCE REQUEST AND OTHER PERMITS**:**

4.1. Digging Permit: AF Form 103, Base Civil Engineering Work Clearance Request, commonly referred to as a "Digging Permit". The contractor shall initiate, prepare, and hand carry for signatures an AF Form 103, Work Clearance Request, 14-28 calendar days prior to any work (***especially*** excavation) activities. Base Civil Engineering will assist the contractor by providing points of contact; however, the responsibility for executing and tracking status of the work clearance request and coordinating utility markings with the Base Civil Engineer shops and/or other utility companies is solely that of the contractor. The contractor shall compose and provide sketches/drawings/ and dimensioning details showing the specific location of the intended area of work (especially excavation) when requesting an AF 103. The contractor shall physically stake, flag, or demarcate (in accordance with base civil engineer work clearance manager) to define the boundaries of all required utility locates at the location of proposed work. The contractor should allow 10-20 days for processing the work clearance request between the various activities that must coordinate on the request. The contractor shall submit to the CO and provide the Construction Representative with a copy of the completed AF Form 103 with all attached record utility drawings, and shall comply with all instructions for hand excavation and other methods of safeguarding the buried utilities prior to on-site work. The contractor shall take caution within the area 3 feet to either side of a utility pre-identified to the contractor. If the contractor damages any utility within this six-foot boundary, the contractor is responsible for restoring the utility to its original working condition. Work to repair the damaged utility will commence immediately and will continue uninterrupted until the utility is restored. If the contractor damages a utility that was not identified or is not within the 6-foot boundary of the utility marking, the contractor shall notify the CO and Construction Representative to determine the method of repair (i.e., in-house or by contract). If the damaged utility requires repair by an outside source or someone not in the contractor's employ (e.g., someone to repair specialty lines) and the contractor is responsible for the damage; the contractor shall coordinate and schedule such persons making the repairs and shall furnish prompt payment for the work to such persons.

4.2. USAF Welding, Cutting, or Brazing Permit: Prior to any soldering, brazing, torch cutting, or welding, the contractor must obtain a signed AF Form 592, USAF Welding, Cutting, or Brazing Permit, from the base Fire Department, Technical Services element. When any of these activities take place in or near a combustible facility or materials, the contractor shall personally coordinate with the fire department for live fire watch provided by the contractor as determined by the fire department. The contractor shall restore any smoke detectors that automatically notify the base fire department (if available), or post a fire guard/watch for 24 hours a day following the activity until the situation is remedied. If frequent or numerous permits will be required contractors must attend Fire Department Task Certification to become task certified to issue their own permits. Contact the Base Fire Department for information. Contractor must submit certification compliance to the Contracting Officer prior to performing any welding, cutting, brazing or open flame work. All fires are to be reported to the Base Fire Department. In the event of an emergency, call 911.

4.3. Demolition and Asbestos Notification: Projects Requiring Notification of Demolition and Asbestos Containing Materials Removal. For projects that include building demolition and asbestos removal, the contractor shall perform necessary actions required to fully complete the North Dakota Department of Health (NDDH) Notification of Demolition and Renovation (form SFN 17987). This form must be submitted to the NDDH in accordance with North Dakota Administrative Code (NDAC) 33-15-13-02.6. A copy of the completed Notification of Demolition and Renovation form, the ND State Health Dept. acknowledgment of receipt letter, and all subsequent revisions of ND State Health Dept. acknowledgments shall be submitted to the CO and the CM prior to the start of demolition and/or asbestos removal activities. NOTE: An asbestos assessment determining the presence of asbestos containing materials must be performed by the contractor to determine the correct choice made in section III of the form SFN 17987. The contractor shall be required to complete and retain the services to meet the requirements of section IX of the form SFN 17987 (if applicable). The contractor shall sign the form in section XX as the operator.

4.4. Air Permit: Air Permit Determination for New Emission Sources. Any new air emission source(s) (hoods, volatile substance storage tanks, spray booths, stationary equipment, boilers, furnaces, generators or other similar type items) to be constructed/installed shall be evaluated by the Air Program Manager at 319 CES/CEIE prior to

commencement of construction for determination of air permitting requirements. In order to gain a determination, equipment specifications and designs shall be submitted to 319 CES/CEIE through the CO prior to start of work.

5. UTILITIES COORDINATION:

5.1. Utility Interruptions/Outages: The contractor shall perform the work under this contract with a minimum of utility outage time for any facility or system. The contractor shall make every attempt to schedule any work that requires utility outages which will close down or limit normal activities in the building, construction area, or other affected areas (as determined by the contractor with coordination of engineering project management personnel) at a time other than regular work periods of the organization occupying the facility. Whenever outages occur on weekends, holidays or after normal duty hours, the contractor shall perform the work at such times as designated at no additional cost to the Government.

5.1.1. Prior to outage: Wherever possible, portions of the work that can be accomplished without an outage shall be done prior to actual outage. All materials, equipment, and labor required to facilitate work during an outage shall be available on site before the utility service is interrupted.

5.2. Approval for outage: The contractor shall submit requests for utility outages a minimum of ten (10) working days prior to initiating the outage. The contractor must receive approval from the CO and/or the Construction Representative (CR) before interrupting utilities. Any disruption of utilities service to the military family housing area shall include coordination with the base housing office. This coordination shall be the responsibility of the contractor. The contractor shall personally coordinate all utility outages with affected facility users and the Base Civil Engineering Operations Flight shops that oversee/control the system(s). Solely notifying only the Construction Representative (CR) is NOT adequate.

5.3. Contractor's Responsibility: The contractor is responsible for shutting down the utility using the contractor's workforce or by requesting the shutdown from the utility company (or Civil Engineer Shop) responsible for the service. The Civil Engineer Shop typically having jurisdiction will shut down the primary utility. Once work begins on an approved outage, work must continue without interruption until utility services to the affected line(s) and/or facility are restored. Exceptions require pre-approval from the CO/CR.

5.4. Procedure: Control of the base electrical system is the responsibility of the Facility Systems Superintendent (CES Operations Flight Bldg 418). All switching of electrical equipment/circuits must be approved by the base Utility Superintendent or designated authorized representative. Work on de-energized high voltage lines or equipment is not permitted until the Base Utility Superintendent or designated authorized representative has issued a safe clearance procedure to the Contractor Superintendent in accordance with AFI 32-1064, (current revision) available at: http://www.wbdg.org/ccb/AF/AFI/afi_32_1064.pdf.

5.5. Communications Utilities (Telephone, Fiber Optic, Cable Television): The contractor shall not disturb communication wiring to facilities. Where such facilities require removal of existing, reconfiguration of existing, and/or installation of new communication equipment and wiring to accomplish the work involved, the contractor shall coordinate with the base Communications Squadron prior to actual work to determine the scope of effort and gain authority from the Communications Squadron to work on communications systems. The contractor shall allow for the accomplishment of such removals by the telephone company or communications personnel for the systems they service. If construction activities damage communications equipment or wiring, the contractor shall restore services as soon as possible, but within no more than 24 hours and at no cost to the government.

5.6. Excavating Around or Locating Existing Utilities: Prior to the start of work, the contractor shall identify and locate all valve or utility shut-off locations for use in the event of accidental damage. To preclude accidental damage, the contractor shall locate all known utilities (i.e., communication, natural gas, fuel supply, water, power, etc.) by hand digging or hydro-excavating prior to any excavation with other power equipment. The contractor

shall note any utilities discovered during excavations that are missing or incorrectly represented on the AF Form 103 and associated attachments, the contract drawings (including any erroneous dimensions on government record drawings), or those utilities staked by the user; and clearly identify those discoveries on project redline and as-built drawings.

5.7. Existing Utilities/Job Site Verification: Record drawings (as-builts) showing existing facilities and underground utilities are available to the contractor through the Base Civil Engineer Drafting Office and Operations Customer Service. The government does not guarantee the accuracy or adequacy of existing as-built/record drawings. The contractor is responsible for field verifying all dimensions and actual conditions when developing project proposals. Failure to verify the dimensions and locations will be at the contractor's risk and shall not relieve the contractor from accomplishing the work required by the contract at the price awarded by the government. The contractor shall immediately repair any utility lines shown on a record drawing (or made known to the contractor via ground marking) and damaged during construction work at no cost to the government. Prior to digging, the contractor shall review available drawings and located utilities to determine if all utilities on the drawings have been located. Should the drawings indicate the existence of an underground utility, but no markings exist to indicate the utility has been located, the contractor shall verify all locates are completed prior to below grade excavations.

6. FIRE REGULATIONS: Compliance with local, Air Force, and NFPA 241 (Safeguarding Building Construction and Building Operation) regulations are mandatory. Fire extinguishers rated and approved by the National Fire Protection Association; of sufficient size, type, and quantity to cope with all known hazards shall be available and provided by the contractor during the execution of this contract.

6.1. Contractor's Responsibility: It is the primary contractor's responsibility to provide personnel properly trained in safe welding, cutting, open flame operations and trained in specific requirements of AFI 91-203 and CFR 1910 252. These individuals shall be certified in writing by the installation Fire Department under issue of the AF Form 592 for the duration of the contract. It shall be the responsibility of the primary contractor to coordinate all certification training instruction with the installation Fire Department.

6.2. Fire Guard: Contractor must post a fire guard for twenty-four (24) hours (or certifies the facility fire safe) after welding, cutting and open flame operations in facilities when the following situations apply:

6.2.1. Fire detection/sprinkler systems cannot be returned to service.

6.2.2. Fire detection/sprinkler systems do not exist

6.3. Fire Protection, Detection, or Suppression Systems: Established systems shall remain operational to the maximum extent possible. Systems in areas unaffected by this contract shall remain operational throughout contract duration. Interruption (disconnection) of systems shall be coordinated a minimum of (7) seven calendar days in advance with the Contracting Officer and the Base Fire Department.

7. CONTRACTOR USE OF PREMISES:

7.1. GENERAL: The government does not guarantee a lot on Grand Forks Air Force Base for contractor use, but there is the possibility for placement of one in Contractor's Row.

7.1.1. Storage Area: All contractor storage shall be located in an area located inside the boundary of the project site and shall be properly screened and secured. Indoor storage areas are not guaranteed by the government, and there are no alternate storage areas on base. The contractor may store materials and trailers off base at the contractor's expense.

7.1.2. A visually acceptable site at Grand Forks Air Force Base is an important construction standard. Contractor storage sites made available on the work site shall be maintained, kept clean and secured by the contractor at the contractor's expense. The contractor shall maintain trailers and portable storage containers in good condition or must remove them when no longer required. The contractor is solely responsible for the security of contractor property and general housekeeping of the project area(s). This includes, but is not limited to, vegetation (weed control) and height maintenance to base standards, daily trash and refuse debris collection and containerization, and construction materials stacked, neatly palletized or enclosed in trailers.

7.1.3. The government will provide utilities (water and electricity) for project work areas when available. The government will NOT modify points of distribution to accommodate contractor project activities. The contractor may modify points of distribution at contractor expense with prior approval from the CO. The government will not provide utilities solely for construction heating purposes. At remote project work areas where no utilities are available, the contractor shall furnish utility services.

7.1.4. When an on-site water source is required and the only reasonable option, the government will furnish water from a fire hydrant or an adjacent facilities point of distribution selected by the Base Civil Engineer with coordination through the Base Fire Dept and the Contracting Officer (CO). The contractor shall provide and install the proper backflow prevention device, valve and hydrant wrench. The contractor shall be liable for any damage caused to government property resulting from improper operation of fire hydrant(s).

7.1.5. Contractor personnel may use existing toilet facilities if available on the premises and approved by the facility occupants/facility manager unless otherwise instructed by the CO or designated representative. At construction sites where toilet facilities are not readily available, the contractor shall provide chemical sanitary toilets. The contractor shall service the chemical toilets regularly subject to government inspection by the base medical officer. The contractor shall correct all identified sanitary deficiencies within 24 hours of inspection.

7.1.6. Elevators: When required, the contractor shall arrange for temporary use of an existing elevator through the CM and CO subject to approval. Only intermittent use of elevators will be approved. The contractor shall provide and maintain suitable and adequate protective covering for the elevator machinery, hatchway entrance, and the interior of the elevator during the period of temporary use. Also, the contractor shall NOT use loads in excess of the rated capacity of an elevator. On completion of the work, the contractor shall remove any protective coverings together with any resultant dirt and debris and return the equipment in a condition equal to or better than initially found.

7.1.7. Explosive Operated Hand Tools: The contractor shall comply with OSHA Standard 1926.302© when utilizing explosive operated hand tools. On the installation, the contractor shall store explosive cartridges in metal containers and limit the quantity to one day's supply. The contractor shall provide adequate controls to prevent loss/theft of cartridges used and stored on the installation.

7.1.8. Severe Weather: The contractor shall develop and be prepared to implement procedures to evacuate and/or protect people and facilities under the contractor's control in the event of severe weather. These procedures shall include provisions for securing or repositioning of equipment. The contractor shall notify the CO of any evacuation procedures. Upon receipt of a severe weather warning, the following sequence of actions shall occur.

7.1.8.1. The CO or designated representative will instruct the contractor of the severe weather warning.

7.1.8.2. The contractor shall take immediate action to tie down, remove, protect, or secure contractor materials and equipment to the satisfaction of the Air Force construction representative, providing reasonable assurance that the severe weather will not damage government property. If the contractor fails to secure materials and equipment and it becomes a hazard, Air Force personnel may accomplish the work and potential charges to the contractor may result thereof.

7.1.9. Temporary Closures: To prevent outside intrusion into a work area, at the end of each day the contractor shall close up each and every exterior fence or security barrier (as applicable) resulting from work. Closure(s) shall remain in place when the contractor is not actively working on the site(s), including each and every day, night, weekends, and holidays to sustain in-place security. Temporary closure(s) shall be constructed of same material as originally removed and anchored in place if necessary, or similar construction as approved by the base civil engineer through the CO.

7.1.10. Access Roads: In accordance with Dirt and Dust Control contained herein, and as required (minimum at the end of each day), the contractor shall inspect for and clear all mud, dirt, debris, foreign objects, or spills of any kind from the contractor's operations (including subcontractors and suppliers) on streets and parking lots used as access to the work or staging areas. The contractor shall ensure all taxiways, runways, parking aprons and hard surfaces in or around the airfield, used to access the work or staging areas, remain clean at all times.

7.1.11. Contractor-Generated Refuse: Prior to completion of the work each day, the contractor shall handle, transport, store, and dispose of all waste materials and rubbish generated by any work under this contract. If the contractor temporarily stores waste material or rubbish in a dumpster controlled by the contractor, the contractor shall secure the dumpster in such a manner that prevents unauthorized use. Unsecured and unattended dumpsters tend to collect stray refuse from other than contract operations. To avoid this, the contractor shall secure the dumpster during non-working times and post signs (if necessary) on the dumpster(s) noting it as NOT FOR PUBLIC USE. On a regular (minimum weekly) basis, the contractor shall remove and dispose of any waste or excess material resulting from any contract requirement, off base at no expense to the government. The contractor shall dispose of such materials in accordance with applicable federal, state, or local laws, ordinance or regulations. Trucks for hauling refuse and waste materials shall have tight fitting covers to prevent spillage on roadways. The contractor shall use designated haul routes as agreed upon in discussions prior to on-site project work.

7.1.12. Excavations: The government will not allow piles of soil to reside in the work area for unreasonable amounts of time. The contractor shall backfill all excavations, for whatever purpose, within one week or gain approval to have excavations remain open longer by the CM through the CO. The contractor shall temporarily repair road cuts with cold patch asphalt to assure a smooth transition until accomplishing final patching. Loose gravel or fugitive materials that can be carried by traffic shall not be used. For all disturbances to grounds, the contractor shall complete final grading within one week of the disturbance/backfilling. The contractor shall complete final landscaping or seeding within acceptable recognized planting seasons for the GFAFB local area, and/or the nursery of origin written recommendations for subject plantings.

7.1.13. Screening: During interior construction of occupied buildings, the contractor shall provide and install non-combustible or self-extinguishing material drop-cloths to isolate areas exposed to debris or noise, or to cover material storage. The contractor shall install visual screening outside the construction site to maintain a neat appearance per section 7.3.4.3 as required by the RFP.

7.1.14. Covered Chutes: The contractor shall construct all chutes for refuse with covers. At a minimum, covers shall fully confine the material to prevent dust dissemination.

7.1.15. Contaminated Soils: Work requested of the contractor may include removal and/or dumping of contaminated soils. Contaminated soils are defined as "soils that contain non-hazardous materials such as aircraft fuel, heating fuel oil, solvents, and other materials as identified by the base environmental coordinator." The contractor shall report any material suspected of containing contaminants to the CO or his/her designated representative. If contaminated soils are discovered, the contractor shall NOT use the contaminated soil/debris for backfill or removed from the base without written approval from the CO, or his/her designated representative. The contractor shall store this soil on an impervious liner, compatible with the contaminant, and covered with the same impervious material. These contaminants shall be tested by the contractor and coordinated with the applicable base

environmental program manager (319 CEIE) as necessary. After determining the soil status, the contractor may move the soil as directed by the 319 CEIE through the CO or the appropriate agency (ND State Health Dept, EPA). See paragraph 13.6.9 for additional requirements and information regarding contaminated soils.

7.1.16. Wet Lands: Excavation in areas designated as "wet lands" is strictly prohibited. 319 CES/CEIE has the most recent inventory and location of wet lands. Prior to planning work, the contractor shall coordinate excavation activities with 319 CES/CEIE to avoid wet land conflicts. Should this type of excavation be required, the requirement will be identified in the RPF and the contractor shall be required to coordinate to ensure the proper wet land excavation permits (Army Corp of Engineers Section 404) through 319 CES/CEIE are obtained prior to work. NOTE Section 404 process may take months to gain the proper permissions to proceed with wet land associated work. Any contractor disturbance of a wet land prior to coordination and gaining permission shall be subject to penalties under the laws of the EPA and State of ND. The contractor shall be liable for penalties and restoration actions imposed by the EPA, State of ND, or Grand Forks AFB through CO determination. See paragraph 13.11 for additional requirements and information regarding wetlands.

7.1.17. HAZMAT: The contractor shall handle and store hazardous materials only in areas approved by the agency responsible for the specific material (i.e., fire department, environmental element, etc.), and comply with the contractor's approved, and the bases Spill Prevention and Countermeasures Plan (319 CES/CEIE: POC). The contractor shall report any spill of oil or hazardous material to the civil engineer service call desk, and take every reasonable precaution to prevent/contain the spillage of oil or other hazardous substances. See paragraph 13.7 for additional requirements and information regarding hazardous materials management.

7.1.18. Disposals: The contractor shall control the disposal of fuels, oils, bitumens, calcium chloride, acids, or harmful materials, both on and off government premises and shall comply with applicable federal, state, county, and municipal laws concerning pollution of rivers and streams while performing work under this contract. The contractor shall NOT dispose of any waste or residual material on the ground or in any storm sewer or drainage system. The contractor shall take special measures to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides, and insecticides from entering public waters. Do not allow water used in on-site material processing, concrete curing, foundation and concrete clean-up, and other waste waters to re-enter a stream if an increase in the turbidity of the stream could result. See paragraph 13.6 for additional requirements and information regarding solid waste management and disposal.

7.1.19. Emissions: The contractor shall limit emissions of organic solvents into the atmosphere. This rule applies to use, clean-up, and disposal of organic, photo chemically reactive, and non-photochemically reactive solvents and materials containing these solvents.

7.1.20. VOC: The contractor shall limit the quantity of volatile organic compounds in exterior paint coatings. This applies to any coatings applied to stationary structures and their appurtenances, pavements, and curbs.

7.1.21. Lead Content: The contractor shall NOT use paints or coatings containing lead in excess of 0.009 percent by weight of total non-volatile content in accordance with Title 16 of the Code of Federal Regulations, Part 1303. Pavement paints or coatings within reach of children in housing, recreation, and public areas shall have zero lead content.

7.1.22. PCBs: The contractor shall deliver all items indicated on the drawings or in the specifications containing PCBs and all oil-cooled transformers removed from service for disposal to a storage area on base as directed by the environmental coordinator through the CO. If equipment labels or catalog data does not specify composition, the contractor shall have all electrical equipment cooling liquid tested by a certified laboratory to determine if PCB is present. Drain and properly contain oil from transformers and flush the system to the required level. Clean, seal, and label all drums. Include an original of the certified report to the environmental coordinator. New electric equipment shall not contain PCBs, shall be certified to this effect, and shall be stamped or labeled "NO PCB".

7.1.23. Noise Control. The contractor shall comply with all applicable state and local laws, ordinances, and regulations relative to noise control.

7.1.24. Recording and Preserving Historical and Archaeological Finds: The contractor shall instruct all employees and subcontractors to carefully preserve all items having any apparent historical or archaeological interest discovered in the course of any construction activities. The contractor shall leave the archaeological find undisturbed and shall immediately report the find to the CO for reporting to the proper authorities.

7.1.25. Vehicle Control: The contractor shall NOT park or drive vehicles on grass areas for shortcuts and/ or convenience. Only equipment required in direct performance of work will be permitted to enter grass areas. The contractor shall repair or replace any damage done to lawns or shrubs caused by construction equipment or related project activities. Contractor personnel shall load all loose debris on trucks leaving the site in a manner that will prevent dropping materials on streets and conform to local ordinances. Fasten a suitable cover such as a tarpaulin over the load before entering surrounding streets. The contractor shall promptly clean up any materials that falls from trucks. The use of cell phones is prohibited on Grand Forks AFB while operating a motorized vehicle. Seat belts are required at all time while driving a vehicle. Base speed limits are strictly enforced and violation(s) may result in suspended base driving privileges.

7.1.26. Equipment Condition: Equipment and vehicles used on base shall be safe and in good operating condition. The contracting officer (CO), CM, Base Safety, or designated representative reserves the right to inspect any on-base equipment and reject such equipment if deemed unsafe, in poor operating condition, or inappropriate for the work being performed.

7.1.27. Government Furnished Equipment: As a rule, the government will NOT furnish equipment/materials (GFE/GFM) except for equipment specified in the solicitation/RFP or elsewhere in these specifications. However, the government reserves the right to provide GFE/GFM for use on any contract or delivery order. In such cases, the contract or delivery order shall contain Schedule D, *Schedule of Government Furnished Property* listing GFE/GFM that pertain to the project. The contractor shall transport all GFE/GFM, if any, from the government storage area to the work site indicated. Once GFE/GFM is released to the contractor for transportation to the project site, the contractor shall assume the risk and responsibility for the loss or damage to GFE/GFM. The contractor shall follow the instructions of the CO or authorized representative regarding the disposition of GFE/GFM not consumed in performance of this contract.

7.2. PLANS:

7.2.1. Project Site Plan: Prior to starting work, the contractor shall submit an individual Site Plan through the CO to the Construction Manager for approval showing the layout and details of all pertinent attributes used for the project. The base approval authority, normally the Construction Manager and/or Base Civil Engineer, will approve the plan prior to on-site activities. The plan shall include the location of the safety and construction fences, location of all site trailers, equipment and material storage area, construction entrances, trash dumpster locations, temporary sanitary facilities, and worker/construction vehicle parking areas. Overhead site diagrams, and or photographs prior to the start of work may be included with the plan. The CM can provide overhead site photographs to assist the contractor in completion of the project site plan. All areas which may have the potential to tracking of earthen materials shall also be identified. The contractor shall also indicate if the use of a supplemental or other staging area is desired. At completion of work, the contractor shall remove the temporary facilities and restore the site to the original, pre-work condition.

7.2.2. Dirt and Dust Control Plan: As part of the project site plan, or as an individual plan, the contractor shall identify and submit for approval truck and material haul routes leading from the base entry point to the work site. This plan shall include details for controlling fugitive dust, dirt, debris, and rubbish generated on established base

haul route/roadway caused by construction activities. As a minimum, the plan shall identify the contractor's equipment utilized for cleaning along the haul route and measures to prevent and reduce dirt, dust, and debris from being deposited and dispersed along roadways. The plan shall also include frequency of maintenance/cleaning.

7.2.3. Health & Safety Plan: The contractor shall submit a complete health and safety plan for the proposed work. Plan/Program shall be in compliance with EM 385-1-1, OSHA, 29 CFR 1910 for industry, and EM 385-1-1, OSHA, 29 CFR 1926 for construction, and other occupational health and safety requirements of the contract as applicable. Plan shall provide a detailed description of procedures to comply with health and safety requirements.

7.3. CONTRACTOR'S TEMPORARY FACILITIES:

7.3.1. Administrative Field Offices: Contractor's administrative field office shall be in good to new condition, and the exterior color must be subdued and neutral. Locations, if granted, shall be pre-approved by the CM/Base Civil Engineer through the CO. Storage of material/debris under the trailers is prohibited. Power and water will be provided by the government in reasonable quantities, and if they are reasonably available within proximity of the approved location. Connections to existing government utilities shall be made by the contractor at no expense to the government. Modification of existing points of distribution from existing government infrastructure shall be approved prior to, and performed by the contractor at no additional expense to the government. Communication lines and service will not be provided by the government. The contractor shall utilize available commercial services as necessary. The duration of such field office presence will be determined by the government upon request of the contractor.

7.3.2. Dumpsters: Dumpsters shall be painted dark brown and equipped with secure covers. The cover shall be closed at all times, except when being loaded with trash and debris. Locate dumpsters behind the construction fence or out of public view. Empty site dumpsters when they attain 90% of full capacity, or as needed to allow full closure of the covers. All other exterior trash containers utilized in the construction site area shall be dark brown. Locate the trash containers behind the construction fence or out of the public view. Empty trash containers as required to prevent over filling. Large demolition normally requires a large dumpster without lids-these are acceptable but shall not have debris higher than the sides before emptying. Ensure mandated recyclable material (paper, glass, cardboard, etc.) is collected and taken to the recycling center at Building 672.

7.3.3. Temporary Sanitation Facilities: All temporary sewer and sanitation facilities shall be self-contained units with both urinals and stool capabilities. Ventilate the units to control odors and fumes and empty and clean them at least once a week or more often if required by the Contracting Officer. The doors shall be self-closing. The exterior color must be subdued and neutral, unless the facility is behind the construction fence or out of the public view.

7.3.4. Construction Site Maintenance, Safety Fence, Construction Fence, and Barricades:

7.3.4.1. Site Maintenance: The construction site must be kept neat, clean, and free of debris. Clean-up shall be performed at the end of each work day in conjunction with a complete general clean up at the end of the project. Cut grass (to include weeds) within the construction and storage sites to maintain a maximum height of 4 inch or less. Trim grass around fences and other obstructions where a mower cannot reach. Grass and/or weeds allowed to grow on stockpiled earth are not acceptable at any height. Contractor identification signs are not required, however if the contractor chooses to erect signs at construction sites, they will be in compliance with base requirements and color scheme and approved by the CM/Base Civil Engineer before being erected.

7.3.4.2. Safety Fence: The contractor shall also provide a temporary safety fence (with gates as applicable) and warning signs at the construction site prior to the start of work to protect the public from construction activities. The safety fence will match the base standard (dark brown or bright orange where it protects excavated areas), high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to

steel posts located on minimum 10 foot centers. The contractor must remove the fence from the work site upon completion of the contract. The fence shall be maintained to avoid sagging and a general state of disrepair while it is deployed on the construction site.

7.3.4.3. Construction Fence: The contractor shall install fences to isolate construction sites as required by the RFP. The construction fence shall be constructed of galvanized chain-link type metal or approved equal, a minimum of 2.13 m (7 feet) high, supported, and tightly secured to steel posts located on minimum 3 m (10 feet) centers. The construction fence shall be covered with dark brown fabric securely attached to the fence with 1"x2"x6' wood batten strips on both sides five feet on center for the purpose of obscuring view of the site.

7.3.5. Indoor Barricades: As necessary, the contractor shall furnish, install, and maintain adequate barricades and warning signs to isolate the construction area from other building entrances, and to block direct access to entrances where stoops and steps have been removed, areas with tripping and falling hazards, and/or areas with adjacent construction hazards.

7.3.6. Outdoor Barricades: The contractor shall furnish, install, and maintain adequate barricades, warning signs, and warning lights to isolate outdoor construction areas. The contractor shall identify and barricade all open trenches and excavations at the end of each work day. In the vicinity of traveled ways (pedestrian and vehicular), the contractor shall use flashing barricades with spacing not to exceed 25 feet. In other areas, the contractor may use unlit barricades, flagging, rope, fences or other suitable means. The contractor shall comply with all pertinent provisions of the Corps of Engineers EM 385-1-1, *Safety and Health Requirements Manual*, including any revisions.

8. GOVERNMENT FURNISHED SERVICES AND UTILITY AVAILABILITY: All reasonable quantities of utilities (water and electricity) will be made available to the contractor without charge. The Government may not be held responsible for interruptions of utility service and shall not be liable for contractor delays, damages, or increased costs occasioned by any such interruption of service.

8.1. Water: A centrally-located water filling station for contractors is located at Facility 328. This is the preferred location to fill water trucks/portable tanks. For more information regarding the filling station, contact the designated construction representative.

8.2. Refuse Collection: The contractor is responsible for disposing of construction debris and contractor-generated refuse at construction sites safely and properly in accordance with this section. The recycle center is for base residents only, contractors shall dispose of recyclables at own expense off-base.

8.3. Insect and Rodent Control: If the contractor detects an insect or rodent problem, notify the appropriate facility manager or construction representative for entomology services.

8.4. Security Police and Fire Protection: The government will provide security police and fire protection services to the extent necessary to ensure a safe, secure construction site. In return for these services, the contractor shall adhere to the security and fire directives, instructions, and policies of Grand Forks AFB.

8.5. Emergency Medical Services: In the event of a severe emergency, the 319th Medical Facility, during hours of operation, will respond and transport, if necessary, a contractor employee to a local hospital. The contractor shall reimburse the government for these services.

9. WORK SEQUENCE:

9.1. Commencement of Work: Notice To Proceed (NTP) letters shall be the instruction to commencement of work for said contract. Work shall begin within the number of days specified on the contract.

9.2. Project Execution: The work performed under this contract will be adjacent to occupied and unoccupied facilities/areas. The contractor shall perform all work with continuous daily progress. The government will not accept or permit days of no work or periods of inactivity by the contractor except for drying or curing of previous work or as directed by the CO. In some cases, the government will require the contractor to work around building entrances or make accommodations for facility access within the overall work area to facilitate the contractor's work and safe access/egress from a facility. The contractor shall protect all government facility exterior appurtenances and landscaping within the work area from overspray, debris, and damage. The government will hold the contractor responsible for any damages caused by contractor operations as a result of lack of adequate protection of government property. NOTE: Once finishes become stained/damaged and cannot be restored, the contractor shall be held responsible to replace such items at no cost to the government. The contractor shall maintain the work site, entry/egress, and vehicular exits free of debris and provide for safe egress at all times. Contractor personnel shall strictly adhere to safety standards (OSHA and AFOSH) and practices at all times during the contract term.

9.3. Forced Work Stoppage: In case of emergency, the contractor shall call 911. The CO, base fire chief, and other base-authorized emergency response personnel, or their representative(s), have the authority to order the contractor to terminate work and clear the area of personnel and equipment. The contractor shall comply with such an order with all possible speed. When the previously mentioned authority figures or representative(s) interrupt the contractor's operations, the contractor shall immediately notify the contracting officer of the delay.

9.4. Interruption of Utility Services: The contractor shall not hold the government responsible for interruptions of utility service. Nor will the government be liable for contractor delays, damages, or increased costs occasioned by any such interruption of service. The contractor, at his own expense, may provide backup power generation and such in the event of base utility outages.

9.5. Work in Secure Areas: The contractor shall comply with security regulations imposed by the installation commander and/or the agency responsible for the project location. Rules of entry will be established and directed to the contractor at the preconstruction meeting for associated projects. For specifics, refer to Section 17 for Base Entry Procedures and Airfield Requirements.

10. ADMINISTRATION REQUIREMENTS:

10.1. CONTRACTOR PERSONNEL REQUIREMENTS:

10.1.1. Subcontractors and Personnel: Furnish a list of key contact personnel of the contractor and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

10.1.2. Supervision: Provide at least one qualifying supervisor capable of reading, writing, and conversing fluently in the English language on the job site during working hours. In addition, if a Quality Control (QC) representative is required on the contract, that individual shall also possess fluent English communication skills. The Contractor shall submit a letter to the CO designating both site supervisor for task delivery orders and a project manager for the duration of contract.

10.1.3. Project Management: The contractor shall have available a project construction manager to respond to the requirements of this contract. The contractor's project manager shall have sufficient authority to effectively manage the contract from the project location or reasonable proximity. The contractor shall notify the CO and the CE Construction Representative when the project manager plans to be absent and/or unavailable to include duration of such absence.

10.2. Records Management Requirements by the Contractor: The contractor shall make available in a timely manner, any permits, reports, or general performance data required in the PWS/SOW. The contractor shall also mark any/all proprietary information in the records submitted to the Air Force/government for Freedom of Information Act purposes. The contractor shall create, handle and maintain records for the Air Force, regardless of medium, (in a pre-agreed medium that can be used by the Air Force) in accordance with the requirements established in AFRIMS Records Disposition Schedule (RDS), AFI 33-322, Records Management program, AFI 33-364, Records Disposition Procedures and Responsibilities, and AFMAN 33-363, Management of Records. Full text versions of these publications are available for download at http://www.e-publishing.af.mil. The contractor's records person should attend Records Management Orientation Training conducted by the Base Records Manager. Inquiries as to the specific actions necessary to meet the requirements established in the above-referenced publication may be directed to the GFAFB Records Management Office at (701) 747-6143 or 319th CS/SCXK, Bldg 314, GFAFB, ND, 58205-6436.

10.3. PRECONSTRUCTION CONFERENCE: After award of the contract, but prior to commencement of any work at the site, the contractor shall meet with the Contracting Officer to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule prices, shop drawings, and other submittals, scheduling, programming, and prosecution of the work. Major subcontractors who will engage in the work shall also attend.

10.4. AVAILABILITY OF CADD DRAWING FILES: After award and upon request, the electronic "Computer-Aided Drafting and Design (CADD)" drawings files will be made available to the contractor for use in preparation of construction data related to the referenced contract subject to the following terms and conditions. Data contained on these electronic files shall not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse shall be at the sole risk of the contractor and without liability or legal exposure to the Government. The contractor shall make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The contractor shall, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files. These electronic CADD drawing files are not construction documents. Differences may exist between the CADD files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic CADD files and the corresponding construction documents. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished CADD files, the signed and sealed construction documents shall govern. The contractor is responsible for determining if any conflict exists. Use of these CADD files does not relieve the contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project. If the contractor uses, duplicates and/or modifies these electronic CADD files for use in producing construction data related to this contract, all previous indicia of ownership (seals, logos, signatures, initials and dates) shall be removed.

10.5. ELECTRONIC MAIL (E-MAIL) ADDRESS: The contractor shall establish and maintain electronic mail (e-mail) capability along with the capability to open various electronic attachments in Microsoft, Adobe Acrobat, and other similar formats. Within 10 days after contract award, the contractor shall provide the Contracting Officer a single (only one) e-mail address for electronic communications from the Contracting Officer related to this contract including, but not limited to, contract documents, invoice information, request for proposals, and other correspondence. The Contracting Officer may also use email to notify the contractor of base access conditions when emergency conditions warrant, such as blizzards, terrorist threats, etc. Multiple email address will not be allowed. It is the contractor's responsibility to make timely distribution of all Contracting Officer initiated e-mail with its own organization including field office (s). The contractor shall promptly notify the Contracting Officer, in writing, of any changes to this e-mail address.

11. NOTIFICATION TO THE CONSTRUCTION MANAGEMENT OFFICE (CMO) AND PROJECT COORDINATION: The contractor shall notify the CMO (Designated Construction Representative) at least seven days in advance of starting all work. This shall include, but is not limited to, notification when the initial work shall begin; when work shall resume after stoppage exceeding five work days; and when work shall begin following all specified exclusion periods. The official Notice to Proceed does not constitute sufficient notification to CMO that work shall begin.

11.1. The contractor shall coordinate all work schedules with the contracting officer (CO) and with the designated Base Civil Engineer Construction Representative (CR) prior to the start of work. The contractor shall participate in progress meetings as directed by the CO and/or the CR. Attendance at these meetings may include the contractor's corporate management representative(s) at the CO's discretion.

11.2. Interruption of Activities to Base Personnel: If it becomes necessary to interrupt base activities in buildings and/or areas for construction purposes (except as otherwise described in the contract), the contractor shall request permission, in writing, from the CO five (5) working days in advance. The contractor shall submit written requests for approved street/parking lot closures ten (10) working days prior to closing of the street/parking lot.

11.3. Not Used

11.4. Not Used

11.5. Contractor Furnished Equipment Data: Approximately ten days prior to project final inspection, the contractor shall furnish the following data to the Contracting Officer.

11.5.1. Equipment List (If required by specification): An itemized equipment list, showing unit retail value and nameplate data including serial number, model number, size, manufacturer, etc., for all contractor-furnished items of plumbing fixtures, mechanical equipment, and electrical equipment installed under this contract.

11.5.2. Warranty: Provide a list of all equipment items which are specified to be warranted accompanied by a copy of each specific warranty. For each specific warranted item, the list shall include the name, address, and telephone numbers of the subcontractor who installed the item, the supplier or distributor, and the manufacturer. The completion date of the warranty period shall correspond to the applicable specification requirements for each warranted item.

11.5.2.1. Warranty Service Calls: The contractor shall furnish to the Contracting Officer the names of local service representatives and/or contractors that are available for warranty service calls and who will respond to a call within the time periods as follows: 4 hours for emergency calls and within 7 days of written notice for all other service calls. The names, addresses, and telephone numbers for day, night, weekend, and holiday service responses shall be furnished to the Contracting Officer and also posted at a conspicuous location in each mechanical and electrical room or close to the unit.

11.6. Work Schedule: Grand Forks Air Force Base standard work hours are 0800 to 1630 hours; Monday through Friday, excluding Federal holidays. Working hours for the contractor will normally align with the base standard hours. If the contractor desires to work during periods other than the base standard work hours, additional Government inspection forces may be required. Therefore, to gain approval to work non-standard hours/days, the contractor shall make a written request to the Contracting Officer a minimum of three working days in advance of the contractor's intention to work during periods other than standard work hours/days. Additionally, if inspectors are required to perform in excess of normal duty hours/days solely for the benefit of the contractor, the actual cost of inspection at overtime rates may be charged to the contractor. These contract price adjustments may be made as directed by the Contracting Officer. Requests to work non-standard work times that do not meet the three day notification rule will be highly scrutinized and not normally approved.

12. SUBMITTALS:

12.1. Material Submittals: After acknowledgment of Notice to Proceed, the contractor shall submit to the Contracting Officer for approval four hard copies of manufacturer's data, catalog cuts, samples, or other information as required for the items on the Material Submittal Schedule and the Technical Provisions and one electronic copy of the same information. No progress payments will be made until all material submittals are received or other arrangements have been made through the Contracting Officer.

12.2. Submittal Preparation: In preparing submittals, it shall be incumbent upon the contractor to clearly and fully demonstrate that proposed materials, systems, or methods meet or exceed all applicable specific requirements of the Technical Provisions. Whenever possible, parameters such as units of measurement, testing protocols and technical vernacular specified in the text will be those employed or referenced by the contractor or his agent in demonstrating compliance. When not possible, the contractor will clearly and fully demonstrate, by written notation, how other parameters, employed or referenced, compare with those specified.

12.3. Shop Drawing Submittals: Shop drawings, when required, shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts and installation instructions. Shop drawings shall be prepared to graphically demonstrate proposed layout and anchorage of materials, equipment and appurtenances; and material/equipment relationships to other parts of the work including clearances for maintenance and operation. They shall also contain complete wiring and schematic diagrams; and any other details to graphically demonstrate that a system has been fully coordinated and will properly function as a unit. See Material Submittal Schedule.

12.3.1. Manufacturer’s instructions pertaining to the use or installation of submitted and approved products, materials, or equipment used or installed in the execution of work under this contract form a part of these specifications as though specifically set forth herein. These instructions apply whether furnished as a normal, usual, or customary practice of the manufacturer or if furnished in response to a requirement stipulated herein. In the event of conflict between the specification of drawings and manufacturers’ instructions, the contractor shall bring such conflict to the attention of the CO for resolution before proceeding with the work involved.

12.4. Test Submittals: See Material Submittal Schedule for tests required.

12.5. Photographs: Photographically document site conditions prior to start of construction operations. Include aerial photographs if applicable and/or available. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color minimum resolution in JPEG file format showing the sequence and progress of work. Take a minimum of 20 digital photographs each week throughout the entire project from a minimum of ten views from points located by the Contracting Officer’s Representative. Submit a view location sketch indicating points of view. Submit with the monthly invoice two sets of digital photographs, each set on a separate CD-R, cumulative of all photos to date. Indicate photographs demonstrating environmental procedures. Photographs for each month shall be in a separate monthly directory and each file shall be named to indicate its location on the view location sketch. The view location sketch shall also be provided on the CD as digital file. All file names shall include a date designator. Cross reference submittals in the appropriate daily report. Photographs shall be provided for unrestricted use by the Government.

12.5.1. Photography on the airfield requires written approval from the OSS commander. The Government (i.e., someone from 319 CES/CEN) will prepare and staff the letter on behalf of the contractor for the project or a specific delivery order. Photos cannot be taken within the airfield fence or on the airfield until a government photo approval letter is approved by the AF and is in the possession of the contractor while in the act of taking photos on the airfield. If the contractor takes photos on their own accord, without an approved letter in hand; they are subject to Security Forces intervention, confiscation of the camera, and removal from the airfield.

12.6. Project Schedule: Prepare for approval a Project Schedule, as specified herein, pursuant to the Contract Clause SCHEDULE FOR CONSTRUCTION CONTRACTS. Show in the schedule the sequence in which the contractor proposes to perform the work and dates on which the contractor contemplates starting and completing all scheduled activities. The scheduling of the entire project, including the construction sequences is required, and is the responsibility of the contractor. Contractor management personnel shall actively participate in Project Schedule development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. The schedule must be a forward-planning as well as a project monitoring tool. Use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions. Make the schedule cost loaded and activity coded. The schedule will provide the basis for all progress payments. If the contractor fails to submit any schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the contractor submits the required schedule.

12.6.1. Construction Schedule: In addition to the requirements of paragraph 12.6, prepare and submit to the Contracting Officer for acceptance prior to start of work a construction schedule in the form of a Critical Path Method (CPM), Network Schedule.

12.6.2. Equipment Delivery Schedule:

12.6.2.1. Initial Schedule: Within 30 calendar days after acceptance of the proposed construction schedule, submit for Contracting Officer acceptance a schedule showing procurement plans for materials and equipment. Submit in the format and content as prescribed by the Contracting Officer, and include as a minimum the following information:

12.6.2.1.1. Description

12.6.2.1.2. Date of the purchasing order

12.6.2.1.3. Promised shipping date

12.6.2.1.4. Name of the manufacturer or supplier

12.6.2.1.5. Date delivery is expected

12.6.2.1.6. Date the material or equipment is required, according to the current construction schedule

12.6.2.2. Updated Schedules: Update the construction schedule and equipment delivery schedule at monthly intervals or when the schedule has been revised. Reflect any changes occurring since the last update. Submit copies of the purchase orders and confirmation or the delivery dates as directed.

12.7. As-Built Drawings:

12.7.1. Exterior Work: All exterior work shall be documented with survey grade GPS as described in 12.10.

12.7.2. Interior Work: All interior work shall be documented with AutoCAD in accordance with the Department of Defense A/E/C CAD Standard.

12.7.3. Redline Markup Drawings: The contractor shall revise 2 sets of paper drawings by red-line process to show the as-built conditions for the duration of the project. These working as-built marked drawings shall be kept current on a weekly basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of

construction shall be accurately and neatly recorded as they occur by means of details and notes. Final as-built drawings shall be prepared after the completion of each definable feature of work (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the contractor prior to submission of each monthly pay estimate. If the contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show, but shall not be limited to, the following information:

12.7.3.1. Utilities: In addition to record drawings, provide for each exterior utility system an electronic drawing set of utility drawings, stamped and signed by a registered professional civil engineer or professional land surveyor, together with two hard copies. Submit within ten working days after each system is in place, but no later than five working days before final inspection. Indicate exterior utilities from the building to the termination point or point of connection to existing system. Include the following:

12.7.3.1.1. Horizontal and vertical controls for new utilities and existing utilities exposed during construction. Reference to station's horizontal and vertical control system.

12.7.3.1.2. Sufficient dimensional control for all important features such as beginning and termination points, points of connection, inverts for sewer lines and drainage collection systems, top of pipe or conduit runs, manholes, cathodic protection appurtenances, valves, valve stem tops, backflow preventers, and other significant features.

12.7.3.1.3. Indicate type and size of all materials used in the construction of the system.

12.7.3.1.4. Indicate bearing and distance on tangent lines. On curves, indicate delta and radius of the curve, also provide X, Y, and Z coordinates at all BC and EC angle points. Indicate horizontal and vertical control for all intersecting and tangent points where utility alignment changes. Indicate X, Y, and Z coordinates at building line and point of connection for straight building laterals or services under 40 feet.

12.7.3.2. The location and dimensions of any changes within the building structure. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

12.7.3.3.. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

12.7.3.4. Changes or modifications which result from the final inspection.

12.7.3.5. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

12.7.3.6. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

12.7.3.7. Systems designed or enhanced by the contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

12.7.3.8. Modifications (change order price shall include the contractor's cost to change working and final as-built drawings to reflect modifications) and compliance with the following procedures:

12.7.3.8.1. Directions in the modification for posting descriptive changes shall be followed.

12.7.3.8.2. A Modification Circle shall be placed at the location of each deletion.

12.7.3.8.3. For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.

12.7.3.8.4. For minor changes, a Modification Circle shall be placed by the area changed on the drawing (each location).

12.7.3.8.5. For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.

12.7.3.8.6. For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.

12.7.3.8.7. The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

12.8. Final As-Built Drawing Preparation:

12.8.1. The redline markup drawings and GPS survey coordinates shall be submitted 10 days before the final inspection for approval by the Contracting Officer and the Contracting Officer's technical representative. Upon approval, the redline markup drawings shall be returned to the contractor.

12.8.2. Preparer Qualifications: The contractor shall, at the contractor's expense, provide a qualified individual or firm to transfer all revisions from the redline markup drawings to the awarded drawings to create the as-built drawings. Upon completion of the transfer, both the redline markup drawings and the as-built drawings shall be submitted to the Contracting Officer for approval. The contractor has 20 calendar days to create the as-built drawings beginning from the day the approved redline markup drawings are returned to the contractor. Work shall be accomplished in a professional manner and comply with the quality standards set forth in the following paragraphs.

12.8.3. Drawing Requirement: One complete set of full-size paper as-built drawings and one electronic set (AutoCAD .dwg format) of as-built drawings on a CD or DVD shall be provided by the contractor for each submittal requirement. Drawings, paper or electronic, shall comply with the latest version of the A/E/C CADD Standard available at: https://cadbimcenter.erdc.dren.mil/. Electronic drawings shall be created in model space at a scale of one to one (1 to 1). A paper space layout will be set up for each drawing. All external references shall be attached and bound to each affected sheet. Drawings must open in the specified AutoCAD format and be ready to plot without manipulation of files, directories, or other encumbrances. No securities or safeguards that would prevent full control of any drawing will be installed. Changes made or inserted shall be completely drawn in AutoCAD to depict changes. Clouding, notation, or photo insertion to indicate changes are not acceptable unless approved in advance and can only be used on rare occasions. Electronic as-built drawings are to be delivered in AutoCAD 2012 compatible format. The contractor shall provide one CD or DVD containing all drawings properly labeled including awarded original drawings that were not changed. All drawings in the set must be clearly distinguishable from construction drawings. The words "AS-BUILT" or "RECORD DRAWING" must be prominently displayed in the drawing area or inside the revisions block of the border. The CD/DVD must also contain a second drawing set electronically plotted to a raster media such as .TIFF, .PDF, or JPEG for fast viewing.

12.9. REAL PROPERTY RECORD: Near the completion of project, but a minimum of 15 days prior to final acceptance of the work, complete, update draft attached to this section, and submit an accounting of all installed property on Form DD1354 "Transfer and Acceptance of Military Real Property." Contact the Contracting Officer for any project specific information necessary to complete the DD Form 1354. For information purposes, a blank DD Form 1354 (fill-able) in Adobe (PDF) may be obtained at: www.dtic.mil/whs/directives/forms/eforms/dd1354.pdf. Submit the completed Checklist for Form DD 1354 of Government-Furnished and Contractor-Furnished/Contractor-Installed items. Attach this list to the updated DD Form 1354. Instructions for completing the form and a blank checklist (fill-able) in Adobe (PDF) may be obtained at: http://www.wbdg.org/ccb/DOD/UFC/ufc_1_300_08.pdf.

12.10. Geographic Information System (GIS) and Computer Aided Drafting and Design (CADD)

12.10.1. The survey data shall be collected in the following manner:

12.10.1.1. The contractor shall use survey grade Global Positioning Systems (GPS) for field data collection at an accuracy level in accordance with “Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy,” published by the Federal Geographic Data Committee (FGDC), dated July 1998. This standards document can be found at: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3 (copy and paste to browser)

12.10.1.2. All survey data collected shall be provided to the Government in digital format with attached Survey Report identifying survey method, equipment list, calibration documentation, survey layout, description of control points, control diagrams, and field survey data.

12.10.1.3. Grand Forks Air Force Base maintains a Trimble base station for survey grade data collection. The contractor may utilize this resource provided they possess the appropriate equipment and chip set for that equipment. The base station runs at 413.25 Mhz and can be used across most of the base without setting up repeaters. This is the preferred methodology for survey grade GPS data collection. Use the established control point located on base. This control point has been verified accurate for survey grade GPS data collection and is the preferred setup location for autonomous base station. Alternatively, a Survey Control Database (consisting of a survey marker database and a survey traverse database) will be produced for all survey control points established under this contract and delivered in ASCII comma-delimited format.

12.10.1.4. The contractor shall use survey grade GPS, at an accuracy level of +/- 2 cm. to collect data to be overlaid onto the installation’s orthophotograph and/or base map. GeoIntegration Office (GIO) will provide support, on a limited basis, to verify survey grade GPS data collection meets Grand Forks Air Force Base survey grade GPS data collection standards.

12.10.2. The contractor shall provide survey grade GPS data feature collection for all new features added as part of this project. Demolished or abandoned features will also be collected using survey grade GPS techniques. Data relating to feature creation and/or demolition shall be provided in non-projected, raw data format when collected. Descriptions of new and abandoned features collected as part of the contract must contain common descriptors and the contractor must provide a key for translation of abbreviated descriptions.

12.10.2.1. WGS 84

- **WGS84 Bounds**: -180.0000, -90.0000, 180.0000, 90.0000
- **Projected Bounds**: -180.0000, -90.0000, 180.0000, 90.0000
- **Scope**: Horizontal component of 3D system. Used by the GPS satellite navigation system and for NATO military geodetic surveying.

GEOGCS =WGS 84
DATUM= WGS_1984
SPHEROID =WGS 84, 6378137,298.257223563
UNIT= degree, 0.01745329251994328

12.10.3. The GPS data shall be delivered accordingly in the following media: (Note: No deviations from the Government's established standards will be permitted unless prior written approval of such deviation has been issued by the Government. All linkages of non-graphical data with graphic elements, relationships between data objects and attributes, and report formats shall be maintained.)

12.10.3.1. CD-ROM: Digital media must have an external label listing format and version of the operating system on which the media was created (e.g. Windows Vista), utility (command) used for writing the files to the media, a short description of contents, and a sequence number if there are multiple volumes.

13. ENVIRONMENT PROTECTION:

13.1. Scope: The contractor shall perform all work in such manner as to prevent the polluting of air, water, or land, and shall follow all applicable federal, state, and local regulations and guidelines.

13.2. Implementation: Within 20 calendar days after Notice to Proceed and prior to commencement of the work at the site, the contractor shall submit in writing to the Contracting Officer (CO) the required environmental plans, if applicable, specified within this section. 319 CES/CEIE must review and approve all plans submitted by the contractor prior to beginning work. The required plans include:
13.2.1. Stormwater Protection Plan (13.3)
13.2.2. Preconstruction Survey (13.4)
13.2.3. Solid Waste Management and Disposal Plan (13.6)
13.2.4. Spill Control Plan (13.8)
13.2.5. Dust Control Plan (13.10)
13.2.6. Wetlands Protection Plan (13.11)

13.3. Stormwater Protection: The contractor shall follow North Dakota and EPA guidance 832-R-92-005 *Storm Water Management for Construction Activities*. Copies are available for review at the Environmental Compliance Office (319 CES/CEIE), Base Civil Engineering, 525 Tuskegee Airmen Blvd., Grand Forks AFB, ND. ND State Department of Health rules and forms are available at http://www.ndhealth.gov/WQ/Storm/Construction/ConstructionHome.htm.

13.3.1. Prior to on-site work on all projects (as applicable), the contractor shall accomplish the appropriate action from the options listed below. The contractor shall prepare the required documents and applications and submit such to 319 CES/CEIEC. On the Stormwater Permit application (if needed) the contractor shall complete with the exception of the owner information. Once approved, 319 CES/CC or CD will sign as owner and will submit to the North Dakota Dept. Of Health as appropriate. Information regarding the permit can be found at http://www.ndhealth.gov/WQ/Storm/Construction/ConstructionHome.htm

13.3.1.1. If Construction Activity (see permit definitions) area is under 1 acre total; contact 319 CES/CEIEC for a copy of the Grand Forks AFB Storm Water Pollution Prevention Plan (SWPPP) and permit. Once SWPPP is completed by contractor, and returned to this office for review and approval, work may begin. Any deviations from these documents must have prior approval from this office.

13.3.1.2. Small Site: If Construction Activity area is between one and five acres; contact 319 CES/CEIEC or visit the North Dakota Department of Health (NDDH) web site to obtain the general small site construction permit, SWPPP forms, and Notice of Intent (NOI) for construction activity. The SWPPP must be completed and approved

by this office prior to beginning any site activity. Allow time for this review and approval process. The NOI must be completed by the contractor as 'operator', and then submitted to this office for review. This office will submit the NOI to the NDDH. Please allow time for the State approval process described in the permit. Work may not begin without an approved SWPPP and Permit.

13.3.1.3. Large Site: If the Construction Activity area will total more than five acres but less than 50, the contractor will follow the above (13.3.1.2) process using the 'large site' permit. If the Construction Activity is greater than 50 acres, the SWPPP will need review by this office and the State Health Department, otherwise same as Large site instructions above.

13.3.2. Certain items not required to be submitted by the State of North Dakota to obtain and comply with the NDPDES general permits shall also be submitted to the CO for approval by 319 CES/CEIEC and the CM. These following items are required at a minimum:
13.3.2.1. Application – Notice of Intent
13.3.2.2. Coverage Letter from the State of North Dakota citing permit number and conditions
13.3.2.3. General Permit
13.3.2.4. Storm Water Pollution Prevention Plan (SWPPP). See http://www.ndhealth.gov/WQ/Storm/Construction/ConstructionHome.htm. Also see paragraph 13.5 this section.
13.3.2.5. Self-Monitoring and Reporting Documents (Self-Inspection Records) at 30 day intervals after start of work
13.3.2.6. Amendments to the original SWPPP as they are developed and deployed
13.3.2.7. Transfer of Ownership or Control – permit transfer/modification (if applicable)
13.3.2.8. Notice of Termination (NOT)
13.3.2.9. Noncompliance Notifications to the State of North Dakota
13.3.2.10. Locations of Records Storage if the project site does not have reasonable on-site location
13.3.2.11. Location of Record Retention location for three years

13.3.3. The contractor shall sign and certify (if applicable) all required documents as the operator.

13.3.4. Certain SWPPP requirements may not be readily available to the contractor, such as soil types on base, name of surface waters, name of municipal storm sewer systems at or near disturbed work area, wetland acreage, locations where storm water is discharged to surface waters, etc. These features shall be obtained from Attachment One of this specification section and/or 319 CES/CEIEC prior to completing the SWPPP as necessary.

13.3.5. The base approval authority, 319 CES/CEIEC, has local preferences for storm water protection on Grand Forks AFB. It is highly recommended that the contactor coordinates and obtains such information prior to submitting the SWPPP for approval.

13.4. Preconstruction Survey: Prior to start of any on-site construction activities, the contractor and the Contracting Officer's representative shall make a joint condition survey after which the contractor shall prepare a brief report indicating on a layout plan the condition of trees, shrubs, and grassed areas immediately adjacent to the site of the work and adjacent to his assigned storage area and access route(s) as applicable. This report will be signed by both the Contracting Officer's designated representative and contractor upon mutual agreement as to its accuracy and completeness. This product will be used for the determination of restoration of the work sites and for dispute of damaged areas. This report is designed to protect the contractor, and not a convenience to the government. This requirement may be waived by the CO upon request and justification from the contractor.

13.5. Industrial Storm Water Protection Plan: Grand Forks Air Force Base has been issued an Industrial National Pollutant Discharge Elimination System (NPDES) permit for industrial storm water runoff, permit number NDR02-0314. The contractor shall be responsible for strict adherence to the Grand Forks AFB NPDES permit, in addition to the contractor's permit. The NPDES permit is available for contractor review at 319 CES/CEIEC, 525 Tuskegee

Airmen Blvd., Grand Forks AFB, ND. The Contractor shall comply with applicable Federal, State, County, and Municipal laws concerning pollution of rivers and streams while performing work under this contract. Special measures shall be taken to prevent pollutants including rock, sand, sediment, dirt, chemicals, fuels, oils, greases, bituminous materials, herbicides, and insecticides from entering public waters (this includes eliminating sediment from entering the storm drain inlets). Water used in on-site material processing, concrete curing, foundation and concrete cleanup, and other waste waters shall not be allowed to reenter a stream if an increase in the turbidity of stream could result.

13.6. Solid Waste Management and Disposal**:** As part of the proposed implementation under paragraph 13.2, the contractor must submit a Solid Waste Management and Disposal Plan (Attachment Two) to the Contracting Officer for review and approval by the CO and 319 CES/CEIE for disposing of any and all waste materials resulting from the work under his contract. The contractor must also maintain a Recycled Materials Log (Attachment Two) that must be submitted to the CO and 319 CES/CEIE within 10 working days from the end of each month for all waste materials disposed of as a result of this contract. Disposal documentation (for example, disposal tickets) must accompany the monthly disposal submittal.

13.6.1. Municipal Waste: Municipal waste generated by the contractor and subcontractors can be disposed of in dumpsters available near the work site. The contractor must bag the waste in typical plastic garbage bags prior to disposal. Because municipal waste is not anticipated to be generated in any large quantities, tracking is not required.

13.6.2. Construction and Demolition Debris: Construction waste and demolition debris must be accounted for in the Solid Waste Management and Disposal Plan and also tracked on the Recycled Materials Log.

13.6.3. Hazardous Waste: Hazardous waste generated on GFAFB by the contractor and subcontractors must be managed and disposed of IAW all federal, state, and local regulations. All hazardous waste generated by the contractor must be disposed of off-site. Hazardous waste must be accounted for in the Solid Waste Management and Disposal Plan. The contractor must provide copies of all hazardous waste manifests to the CO and 319 CES/CEIE.

13.6.4. Universal Waste: Universal waste (e.g. used lamps, batteries, mercury devices, etc.) must be managed and disposed of properly IAW all federal, state, and local regulations and guidelines. All universal waste must be disposed of off base at appropriate facilities. All universal waste encountered during the execution of this contract must be accounted for in the Solid Waste Management and Disposal Plan and the Recycled Materials Log.

13.6.5. Asbestos Waste: Asbestos-containing waste must be properly handled and disposed of IAW all federal, state, and local regulations and guidelines. All asbestos waste must be disposed of off base at an appropriate facility. Asbestos waste must be accounted for in the Solid Waste Management and Disposal Plan. An Asbestos Notification of Demolition and Renovation (Attachment Three) must be completed and submitted to the NDDH. Copies of the notification and subsequent NDDH correspondence must be provided to the CO and 319 CES/CEIE. Copies of the all Asbestos Waste Manifests (Attachment Four) must also be provided to the CO and 319 CES/CEIE.

13.6.6. Lead-Based Paint (LBP) Waste: LBP waste generated under this contract must be properly managed and disposed of IAW all federal, state, and local regulations and guidelines. LBP waste must be disposed of off base at an appropriate facility. LBP waste must be accounted for in the Solid Waste Management and Disposal Plan. A copy of all LBP waste manifests must be provided to the CO and 319 CES/CEIE.

13.6.7. PCB Waste: PCB waste must be properly managed and disposed of IAW all federal, state, and local regulations and guidelines. PCB waste includes, but not limited to, contaminated soils, items, articles, containers,

and electrical equipment that contain PCBs. All PCB-related waste must be disposed of off base. PCB waste must be accounted for in the Solid Waste Management and Disposal Plan. Copies of disposal documents and waste manifests must be provided to the CO and 319 CS/CEIE.

13.6.8. Recycling: As previously mentioned in 13.4.1, municipal waste generated by the contractor will not be tracked. However, the Contractor is encouraged to recycle certain municipal waste streams off base that might be generated during the course of this contract. The waste streams that could be recycled include, but limited to, the following:
13.6.8.1. Aluminum and Tin Cans
13.6.8.2. Mixed Plastic (1-7)
13.6.8.3. Glass Bottles and Jars
13.6.8.4. Newspaper
13.6.8.5. Cardboard
13.6.8.6. Magazines
13.6.8.7. Office Paper
13.6.8.8. Junk Mail
13.6.8.9. Paperboard (cereal and soda boxes)

All recycled materials generated from the project (e.g. renovation or demolition debris) must be accounted for on the Recycled Materials Daily Log (Attachment Two). The Daily Log must account for those materials recycled and those recycled commercially off-base.

13.6.9. Petroleum-Contaminated Soil (PCS): Any and all pre-existing petroleum-contaminated soils (PCSs) encountered during the course of this project that requires removal from the project site due to excess soil or inadequate engineering properties must be removed, transported, and disposed of at an off-installation site permitted by the appropriate state agency. Expenses for these actions must be provided for by contract/project funds. The contractor is not obligated nor expected to remove PCS for the sake of "chasing" the PCS for removal and replacement with "clean" soil. The Contracting Officer must be notified of any PCS encountered during the course of this project. Any PCS removed from the project site and transported off-base must be documented (date, quantity, disposition site) and submitted to the Contracting Officer.

13.7. Hazardous Materials: IAW AFI 32-7086, *Hazardous Material Management*, contractors using hazardous materials on GFAFB must comply with the authorization procedures contained in sections 2.5.3 and 2.5.5 of the instruction.

13.7.1. IAW FAR Clause 52.223-3, each offeror must provide the Contracting Office with a list of proposed HAZMAT that it plans to use on the installation during the performance of the contract. Per AFI32-7086 paragraph 2.5.5, contractors shall obtain Air Force authorization prior to using HAZMAT on an Air Force installation and must report usage data to the HAZMART. Contractors must submit to the Contracting Office the following information and supporting documentation (including SDSs) necessary to obtain HAZMAT usage authorization:
13.7.1.1. a listing of the anticipated hazardous materials to be used on the installation
13.7.1.2. all material SDSs (formerly referred to as MSDSs) in individual pdf format
13.7.1.3. all container sizes for each material (16 oz., 5 gallon, 1 pint, etc.)
13.7.1.4. all container types for each material, (plastic bottle, plastic pail, metal can, etc.), and
13.7.1.5. initial inventory of all hazardous material to be brought on base.

13.7.2. The Contracting Office will transmit the contractor submittal to the HAZMART for processing. If the HAZMAT is a Class I ODS, the contracting officer must also have a copy of the applicable and current SAO approval of the Class I ODS requirements (see paragraphs 4.3.1., 4.3.6., and 4.5. of the instruction). NOTE: Contractors are not required to coordinate with a government UEC or Unit Safety Representative.

13.7.3. For each contractor-identified HAZMAT that the HMMP team determines does not meet the Air Force definition of a HAZMAT, the IHMP requirements do not apply. The HMMP team will notify the Contracting Office that the contractor has authorization to bring and use that material on the installation without reporting usage.

13.7.4. If the contractor needs to bring a material on the installation that was not included in the original HAZMAT listing, the contractor must first notify the Contracting Office and then obtain prior authorization, if the HMMP team determines the material to be a HAZMAT.

13.7.5. All hazardous materials must be approved through the above process prior to bringing any hazardous material on the installation.

13.8. Spill Control Plan: The Spill Prevention and Control Plan (Attachment Five) must be submitted to the CO for review and approval by the CO and 319 CES/CEIE. All hazardous material/waste spills must be reported to the Contracting Officer. Any release of a hazardous material/waste which is beyond the capability of the contractor must be reported to 911 immediately. The contractor will notify and provide complete documentation of spills to the CO and 319 CES/CEIE. Documentation will include the date and time of spill, location, quantity, and an MSDS of the spilled material. It is the contractor's responsibility to restore the spill area to pre-spill conditions. Spent spill kit materials as well as contaminated soil must be properly disposed of off base IAW federal, state, and local regulations and guidelines. 319 CES/CEIE will file any required reports with appropriate federal, state, and local agencies.

13.9. Air Permit: Any new air emission source(s) (hoods, volatile substance storage tanks, spray booths, stationary equipment, boilers, furnaces, generators, hot mix asphalt/concrete plants or other similar type items) that are to be installed or removed must be evaluated by 319 CES/CEIE prior to commencement of construction and/or purchase for determination of a Permit-to-Construct and potential modification to the installation's existing Title V Operating Permit. All new sources are subject to NDAC 33-15-12 for air quality compliance.

13.10. Dust Control Plan: The contractor shall comply with NDAC 33-15-17-03, *Reasonable Precautions for Abating and Preventing Fugitive Particulate Emissions*, and maintain all excavations, stockpiles, access roads, waste areas, and all other work areas to include concrete saw-cutting free from excess dust in accordance with NDAC 33-15-07-03. Approved temporary methods consisting of sprinkling or similar methods will be permitted to control dust. Dust control shall be permitted as the work proceeds and whenever dust nuisance or hazard occurs. The contractor shall be responsible for performing all dust control work in accordance with EPA 832-R-92-005, Chapter 3. The methods the contractor will use to control dust in any areas affected by the project will be addressed in the Dust Control Plan. The Dust Control Plan must be submitted to the CO prior to beginning of work for review and approval by the CO and 319 CES/CEIE.

13.11. Wetlands Protection: Excavation and/or filling in areas designated as "wetlands" is strictly prohibited. Prior to planning work the contractor shall coordinate excavation and/or filling activities with 319 CES/CEIE to avoid wetland conflicts following EO 11990. Type of work may include but is not limited to any trenching/boring, demolition, building of access roads temporary or permanent, and/or installing culverts as required infrastructure for the project that would impact adjacent wetlands. Any work that would disturb wetlands requires Clean Water Act Section 404 permits (through the Army Corp of Engineers), and these are obtained through 319 CES/CEIE prior to work. The application process will require a plan for wetlands restoration and best management practices. The contractor is responsible for completing planned wetland restoration work. The section 404 process may take a few months to gain the proper permissions to proceed with dredging/filling/trenching of wetlands. It is strongly suggested this effort take place, prior to scheduling work. Any contractor disturbance of a wetland prior to coordination and gaining permission shall be subject to penalties under the laws of the EPA, Army Corps of

Engineers, and the state of ND. The contractor shall be liable for penalties and restoration actions imposed by the EPA, State of ND, or Grand Forks AFB through CO determination.

13.12. Protection of Endangered, Threatened Plants, Animals and Migratory Birds: Contractor shall obtain approval from the Contracting Officer before removing or relocating any threatened or endangered plants or animals within the construction boundaries. Migratory Birds are protected by the Migratory Bird Treaty Act and EO 13186, "*Responsibilities of Federal Agencies to Protect Migratory Birds*." As such, the contractor is not allowed to take any birds listed in 50 CFR 10.13. Take is defined as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or any attempt to carry out these activities." A take does not include habitat destruction or alteration, as long as there is not a direct taking of birds, nests, eggs, or parts thereof. Protected migratory birds include such species as common songbirds, waterfowl, shorebirds, hawks, owls, eagles, ravens, crows, mourning doves, swifts, martins, swallows and others. A permit is required to take a migratory bird including its nest, eggs, and feathers.

13.13. Trees and other natural vegetation: Trees, shrubs and other vegetation are natural resources owned by Grand Forks AFB. Removal of trees as DoD property must comply with 10 USC 2665, DODI 4715.03, and AFI 32-7064. The AF cannot give away, abandon or destroy forest products with marketable value. Marketable value must be appraised by the AF and is a complex decision based on value, demand, ease of access, and other local factors. Sale of forest products must be compatible with the base INRMP. Should any trees that are contained in a fenced area under the control and maintenance of the contractor become infected with Dutch elm disease or infested with emerald ash borer, the contractor is required to report said condition and work with the base to remove diseased tree. Diseased trees must be disposed by chipping or burial in an approved landfill or IAW with all laws.

13.14. Noxious Weeds: Institute best management practices to limit potential weed seed transport from infested areas to non-infested sites following EO 13112. Avoid activities in or adjacent to heavily infested areas or remove seed sources and propagules from site prior to conducting activities. Should noxious weeds be allowed to grow in fenced and/or contained areas under control of the contractor, the contractor shall be responsible to remove the weeds and return the site area to prior original condition. The contractor shall be liable for penalties and restoration actions imposed by the EPA, State of ND, County Weed Board, or Grand Forks AFB through CO determination.

13.15. Cultural Resource Protection: Prior to any building modification and/or demolition, ensure the building is not a historic resource. If the structure is a historic resource, coordinate with 319 CES/CEIE to ensure planned modifications and demolition activities are approved by the State Historical Society. Bones or other historical/cultural artifacts exposed during the course of excavation on the base will be preserved and all work will immediately be halted until the proper authorities have been notified and the bones and/or artifacts have been evaluated as to their nature and relevance. Security Forces and the CRM must be immediately notified to ensure the safety and security of the remains and/or artifacts. The CRM will determine with the aid of the coroner and/or forensic anthropologist if the remains are human and follow all local, state and federal laws.

13.16. Environmental Management System Awareness Training: Contractor will ensure all personnel within 30 days of contract start date contact 319 CES CEIE (Environmental Management) at 747-6153 to take the *AF Environmental Management Systems Awareness Training*. This training is mandatory and is required to maintain compliance with Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management", dated 24 January 2007.

14. CONTRACTOR QUALITY CONTROL (CQC): The contractor shall establish and maintain an effective Quality Control Program as follows:

14.1. General: The contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the contract clause entitled "Inspection of Construction." The quality

control system shall consist of plans, procedures, and organization necessary to manage all delivery orders to produce end products which comply with the contract requirements. The system shall cover all construction operations, both on site and off site, and shall be keyed to the proposed construction sequence. The government will hold the project manager responsible for the quality of work on the job and is subject to removal by the contracting officer (CO) for non-compliance with quality requirements specified in the contract.

14.2. Payment: Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in contractor's price.

14.3. Preconstruction Planning: Prior to starting onsite construction, the contractor shall submit for approval the written QC plan.

14.4. Submittal of CQC Plan: Acceptance of the contractor's quality control plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the contractor to make changes in his CQC plan and operations as necessary to obtain the quality specified.

14.5. Contractor's Proposed (QC) Plan: The contractor's proposed written quality control plan shall include as a minimum:

14.5.1. Weekly Construction Meetings

14.5.1.1.. Weekly Minutes

14.5.1.2. Designated Meeting Location

14.5.2. The quality control organization including a chart showing lines of authority

14.5.3. Names, number, and qualifications of personnel to be used for this purpose

14.5.4. Authority and responsibilities of all quality control personnel

14.5.5. Schedule use of inspection personnel by types and phase of work

14.5.6. A list of tests specified to be performed with proposed test methods including specification paragraph number and names of technicians or qualified testing laboratory to be used

14.5.7. Location and availability of test facilities and equipment

14.5.8. Procedures for advance notice and coordination of special inspections and tests where required

14.5.9. Procedures for reviewing all shop drawings, samples, certificates, or other submittals for contract compliance and certifying these for submission to the Government

14.5.10. Method of performing, documenting, and enforcing quality control operations of both prime and subcontract work including inspection and testing both onsite and offsite. Include the proposed forms for approval, and indicate who will prepare, sign, and submit the reports.

14.5.11. Responsibilities and procedures for correcting deficiencies and corrective actions

14.5.12. A copy of a letter of direction to the contractor's representative responsible for quality control, outlining his duties and responsibilities, and signed by a responsible officer of the firm

14.5.13. Method of documenting and tracking deficiencies and corrective actions

15. FOLLOW-UP INSPECTIONS: Inspections shall be performed continuously as any particular feature of work progresses, to assure compliance with contract requirements including control testing, until completion of that feature of the work.

15.1. Safety Inspections: The contractor shall perform daily safety inspections of the jobsite and the work in progress to assure compliance with EM 385-1-1 and other occupational health and safety requirements of the contract. Daily Quality Control reports as required under paragraph: REPORTING shall be used to document the inspection and shall include a notation of the safety deficiencies observed and the corrective actions taken. The contractor shall use his designated Quality Control Staff to perform the required inspections and shall supplement the staff with additional personnel as required.

15.2. Quality Control Staff: The contractor's job supervisory staff may be used for quality control supplemented as necessary by additional personnel for the controls required by the specifications. The contractor's staff member designated as the QC Supervisory Engineer for the contract must be a qualified engineer or technician and be able to demonstrate ability to perform correctly the duties required to the satisfaction of the Contracting Officer and must be available whenever contract work is in progress.

15.3. Testing Procedure: The contractor shall perform tests specified or required to verify that control measures are adequate to provide a product which conforms to contract requirements. The contractor shall procure the services of an industry recognized testing laboratory approved by the Contracting Officer, or may establish an approved testing laboratory at the project site. The contractor shall perform the following activities and record and provide the following data:

15.3.1. Verify that testing procedures comply with contract requirements.

15.3.2. Check test instrument calibration data against certified standards.

15.3.3. Verify that recording forms, including all of the test documentation requirements, have been prepared.

15.4. Reporting: All inspections and test results shall be recorded daily.

15.4.1. Daily Submittals: The attached sample "Quality Control Daily Report" (Section 19) form or other approved form shall be reproduced and fully executed to show all inspections and tests and submitted in duplicate to the Contracting Officer's representative on the first work day following the date covered by the report.

15.4.2. Acceptance of the contractor's daily Control Report does not indicate or imply agreement with the contents.

16. OPERATING MANUALS: See the Material Submittal Schedule for operating manuals required. All operating manuals and test reports contained therein shall be submitted on CD in portable document format (PDF). The contractor shall provide system operating manual(s) to include the following elements:

16.1. Introduction: Includes a general process or system description for each HVAC, refrigeration, plumbing, fire protection, electrical, or other system(s).

16.2. Flow Diagram: Indicates in a single line flow diagram all major components affecting the system performance in operation.

16.3. System Operation: Provides a sequence of operation describing the individual function of each system component, its set point, and resulting action during different conditions or operating cycles. The sequences of operation shall explain manual and automatic start and stop procedures.

16.4. Identified Areas Serviced: Identifies the type of system which is serving a respective area, and enables the operating staff to troubleshoot the system and respond to a complaint in as short a time as possible.

16.5. Troubleshooting Procedures: Shall outline normal troubleshooting procedures as well as troubleshooting efforts that should be followed in response to an alarm.

16.6. Emergency Procedures: Shall outline what action shall be taken on a system under emergency condition in order to assure life safety and prevent physical damage to system components.

17. BASE ENTRY PROCEDURES AND AIRFIELD SECURITY REQUIREMENTS:

17.1. Base Entry Procedures: Security requirements for Air Force facilities under control of Grand Forks Air Force Base are specific and rigidly enforced. Levels of security include Restricted and Controlled areas. Differing degrees of security are enforced at each area. Minimum security requirements, common not only to each of these secure areas, are also required for entry onto Grand Forks AFB. Questions of clarification on locations or procedures for controlled/restricted areas contact Security Forces at 701-747-5351. These minimum requirements are outlined below.

17.1.1. Restricted Areas: Restricted areas are identified in GFAFBI 31-101 and include the Command Post (CP) and Mass Parking Area (MPA). Each area is fenced or conspicuously identified by posted signs.

17.1.2. Controlled Areas: Controlled areas include more than forty-four user-controlled base facilities; only a few of which include all hangars, buildings, and communications facilities located within the base aircraft flight-line controlled area. Each of these areas is identified in GFAFBI 31-101 and each is conspicuously identified by posted signs.

17.2. Not Used

17.3. Work in Controlled Areas.

17.3.1. Controlled Areas: Rooms 109, 110, 111, 111A, 111B and 112 within Building 516 are controlled areas. The contractor shall provide Government-approved security escorts while performing contract work in these rooms.

17.4. Minimum Security Requirements: (All Areas Including Base Entry).

17.4.1. Visitor Passes: The Commercial Visitor Control Center will issue a SFMIS AF Form 75 (Visitor Pass) to the contractor and employees upon completion of screening process for the duration of the contact. The screening process takes time, and the contractor shall visit the Commercial Visitor Control Center prior to expecting base entry to receive required forms and instruction on the application process, to include estimated time of receiving the visitor pass.

17.4.2. Vehicles: Although contractors will not be issued vehicles passes, vehicles are subject to search while on the installation. Employee privately-owned vehicles will not be allowed access to restricted/controlled areas without a free zone being established. Company vehicles will be allowed access to restricted/controlled areas.

17.4.3. All Contractor vehicles shall have markings with the company name for quick identification of ownership and notification if they are involved in an incident.

17.4.4. Conduct Requirements. The contractor shall ensure that all contractor employees comply with all base traffic regulations and properly conduct themselves while on the base.

17.5. Antiterrorism Requirements:

17.5.1. Eagle Eyes: Contractor will post OSI Eagle Eyes posters in the work area. Posters will be made available by the Installation AT Officer.

17.5.2. Training: Shift supervisors and/or Foreman will be required to attend Antiterrorism Level 1 training. Training will be provided by the Installation AT Officer or the Contracting Office.

18. SITE VISITS: A contractor site visit will be arranged. It shall be scheduled by 319 CONF/LGC prior to the established bid opening date.

19. CONSTRUCTION QUALITY CONTROL DAILY REPORT FORM:

CONSTRUCTION QUALITY CONTROL DAILY REPORT
COMPANY/QC Representative:

REPORT NO: CONTRACT NO: DATE:
LOCATION OF WORK:
DESCRIPTION:
WEATHER: RAINFALL: TEMP MIN: TEMP MAX:

1. Work Performed Today by Prime Contractor:

2. Work Performed Today by Subcontractors:

3. Type and Results of Inspection (Follow-up and Include Satisfactory Work Completed or Deficiencies with Action to be Taken):

4. List Type and Location of Tests Performed and Results of These Tests:

5. Verbal Instructions Received from Government Personnel on Construction Deficiencies or Re-Testing Required:

6. Safety Violations Observed and Actions Taken:

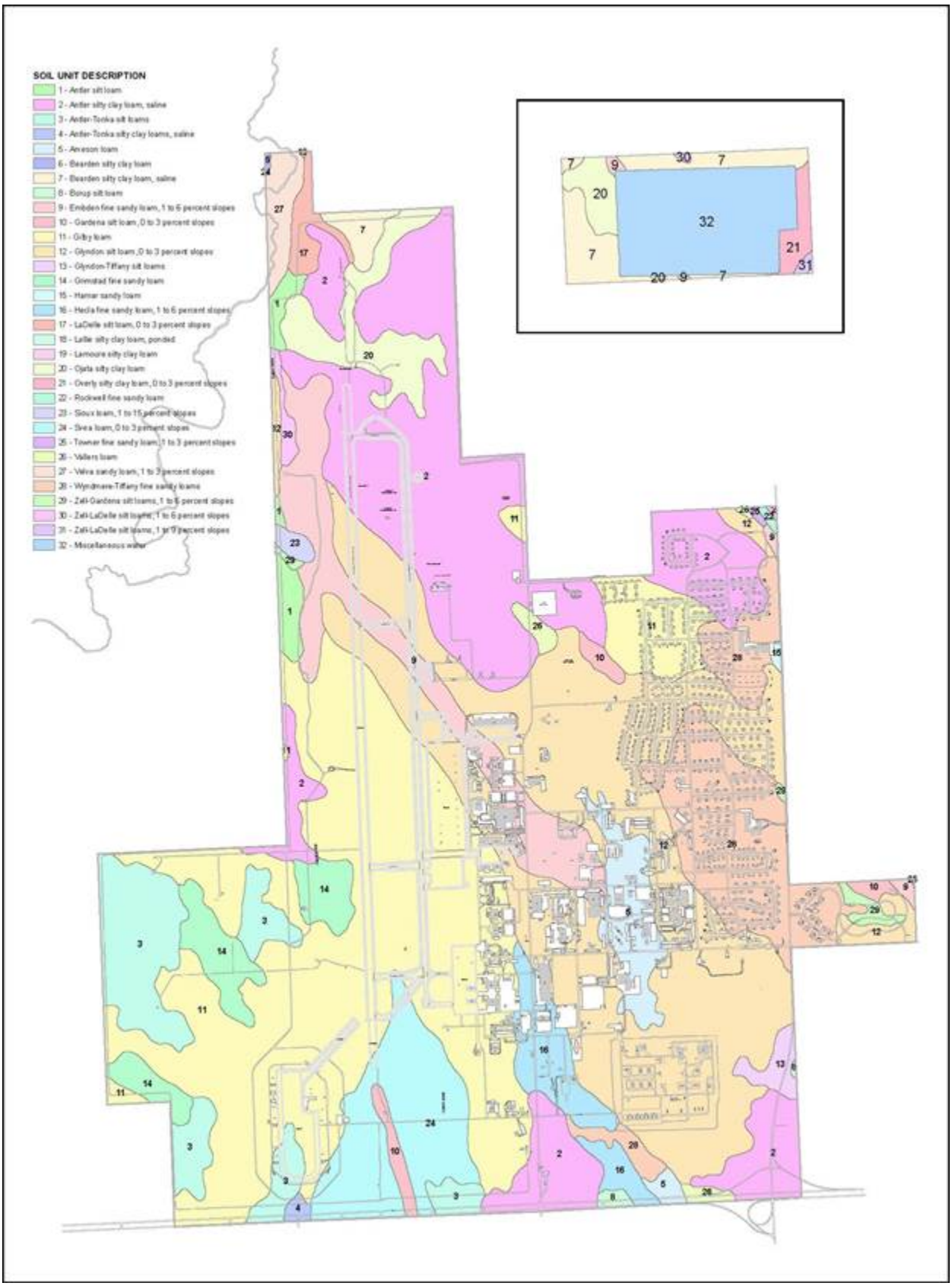
7. Remarks:

8. CERTIFICATION: I certify that the above report is complete, correct and that I, or my authorized representative, have inspected all work performed this day by the prime contractor and each subcontractor and have determined that all materials, equipment, and workmanship are in strict compliance with the plans and specifications, except as may be noted above.

_____

Designated Quality Control Representative Signature/Date

20. ATTACHMENT ONE



21. ATTACHMENT TWO
Solid Waste Management and Disposal
(***Fillable documents can be obtained from 319 CES/CEIE***)

1) WASTE STREAM:	2) COLLECTION METHOD	3) SECURING THE LOAD	4) TRANSPORTATION	5) DISPOSAL SITE	6) PERMIT NUMBER
Demolition Debris:					
Wood:					
Concrete:					
Concrete Washout:					
Asbestos:					
Lead-based paint:					
Trees/Brush:					
Metals:					
White Goods:					
Refrigerant:					
Paper:					
Aluminum Cans:					
Glass:					
Fluorescent Bulbs:					
Hazardous Waste:					
PCB Waste:					

RECYCLED MATERIALS LOG

Month/Year: _____

Project Name:

JFSD #:

DAY of the Month	CONCRETE (yds)	STEEL (lbs)	ALUMINUM (lbs)	MISC METAL (LBS)	GLASS (lbs)	PAPER (lbs)	CARDBOARD (lbs)	WOOD (lbs)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
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21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
TOTALS:								

NOTE: If a recycled material is not listed above (e.g. asphalt), cross out a heading not used and replace it with the material being recycled.

SOLID WASTE MANAGEMENT
AND
DISPOSAL PLAN

Project Title: _____ Project #:_____

Contractor: _____ Date: _____

Signature: _____

1) Will waste materials be generated during this project? Circle: **YES** / **NO**

2) If "**YES**" for 1), complete the attached table and continue to 4). Include all waste streams on the table except municipal waste.

3) If "**NO**" for 1), **STOP!** The Plan is complete and can be submitted as-is.

4) Will waste materials be recycled? Circle: **YES** / **NO**

5) The attached ***Recycled Materials Daily Log*** must be used to track quantities. The Daily Log must be submitted to the CO and 319 CES/CEIE within ten (10) working days after the end of each month.

6) Section 13.6 of the specification addresses various waste streams that can be generated during the course of a project. All federal, state, and local regulations and guidelines must be followed regarding the proper management and disposal of these and all waste streams.

7) Proof of final disposition: Contractor must provide proof of disposal or recycling to the CO and 319 CES/CEIE. Disposal tickets can be included with the Daily Log submittal.

7) Periodic and random inspections of the project will be made. Noncompliance issues will be noted to the CO. Severity of noncompliance and timeframe to rectify will be at the discretion of 319 CES/CEIE and the CO.

TABLE COMPLETION INSTRUCTIONS:

Column **1) Waste Stream:** Some typical waste streams are listed, but add those waste streams that will be generated during the project. Also, include the hazardous waste streams that will be generated in this table.

2) Collection Method: State how that waste stream will be collected (e.g. dumpster, bags, piled on the ground, etc).

3) Securing The Load: State how the load will be secured (e.g. roll-up tarp over truck, bags in cube van, tie-downs on flat bed, etc).

4) Transportation: State how the waste will be transported to the disposal or recycling facility. Include any details regarding placarding the truck.

5) Disposal Site: State the facility by name that will receive each waste stream identified in the table.

6) Permit Number: Include the facility permit number (typically a NDDH or MN MPCA permitted facility). Recycling centers may or may not have a state-issued permit, therefore write "NA" for Not Applicable" if that is the case.

22. ATTACHMENT THREE
Demo Notification Plan
(***Fillable documents can be obtained from 319 CES/CEIE***)

ASBESTOS NOTIFICATION OF DEMOLITION AND RENOVATION

North Dakota Department of Health
Division of Air Quality
SFN 17987 (12/05)

I. Type of Notification **THIS NOTICE MUST BE SUBMITTED 10 DAYS BEFORE BEGINNING THE ACTIVITY**

☐ Original ☐ Revised ☐ Cancelled	Date:

II. Type of Operation **III. Is Asbestos Present?**

☐ Demolition ☐ Renovation ☐ Ordered Demolition ☐ Emergency Renovation	☐ Yes ☐ No

IV. Dates of Asbestos Removal (MM-DD-YY)	**V. Dates of Demolition or Renovation (MM-DD-YY)**
Start: Stop:	Start: Stop:

VI. Facility Information (identify owner and operator, if applicable)

Owner Name			
Owner Address	City	State	Zip Code
Contact Person		Telephone Number	
Operator (if different than owner)			
Operator Address	City	State	Zip Code
Contact Person		Telephone Number	

VII. Facility Description (include building name, number and floor or room number)

Building Name				
Building Address	City	State	Zip Code	County
Site Location (floor or room number(s))				
Building Size (Sq. Ft.)	Number of Floors			Age of Building/Year Built
Present Use	Prior Use			

VIII. Asbestos Contractor or Demolition Contractor

Contractor Name			ND License Number
Contractor Address	City	State	Zip Code
Contact Person		Telephone Number	

IX. Asbestos Inspector or Project Monitoring Firm (if applicable)

Firm Name			ND License Number
Firm Address	City	State	Zip Code
Name of Inspector or Onsite Hygienist		Telephone Number	

X. Approximate Amount of Asbestos, Including:

	Regulated Asbestos-Containing Material (RACM) to be Removed	Nonfriable Asbestos-Containing Material to be Removed		Nonfriable Asbestos-Containing Material not to be Removed	
		Category I	Category II	Category I	Category II
Surface Area (Sq. Ft.)					
Volume from Facility Component(s) (Cu.Ft.)					
Pipe (Linear Ft.)					

23. ATTACHMENT FOUR
(***Fillable documents can be obtained from 319 CES/CEIE***)

ASBESTOS WASTE MANIFEST FORM
North Dakota Department of Health
Asbestos Control Program
SFN 58174 12/05

I. WASTE GENERATOR (BUILDING OWNER, BUILDING MANAGER, OR PROJECT CONTRACTOR)

Operator or Contractor Name	Operator or Contractor Address	City
State	Zip Code	Phone Number
Owner Name	Owner Address	City
State	Zip Code	Owner Phone Number
Work Site Name	Work Site Address	City
State	Zip Code	Site Location (floor and/or room number)
Description of Materials	Number of Containers/Bags	Total Quantity (square yards or pounds)
Special Handling Instruction and/or Additional Information		
Owner or Operator's Certification: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.		
Signature of Owner or Operator		**Date**

II. WASTE TRANSPORTER

Waste Transporter Name	Transporter Address	City
State	Zip Code	Phone Number
Transporter Signature	Date Transported	

III. WASTE DISPOSAL SITE

Name of Disposal Site (landfill)	Landfill Address	City
State	Zip Code	Phone Number
Waste Disposal Site Owner or Operator Name	Waste Disposal Site Owner or Operator Title	
Waste Disposal Site Owner or Operator Certification: To the best of my knowledge, I hereby declare that the contents of this consignment are fully and accurately described on this manifest and there are not discrepancies between the amount listed above and the amount I have received, unless otherwise noted. I also certify there is no improperly enclosed or contained waste.		
Signature of WDS Owner or Operator		**Date**

The owner or operator must submit a copy of this completed form within 10 days of receiving the form from the disposal site operator.

Return completed form to
Asbestos NESHAP Coordinator:

North Dakota Department of Health
Division of Air Quality, 2nd Floor
918 East Divide Avenue
Bismarck, ND 58501-1947
Phone: 701.328.5188
Fax: 701.328.5185

24. ATTACHMENT FIVE

SPILL PREVENTION
And
CONTROL PLAN

Project Title: _____ Project #:_____

Contractor: _____ Date: _____

Signature: _____

1) Will the project use materials on-site that could cause a spill? **YES** / **NO**

2a) If "YES" for 1) above, complete the attached table and continue to 3).

2b) If "NO" for 1) above, **STOP!** The Plan is complete.

3) Contractor-generated petroleum-contaminated soil (PCS) will be removed and transported to an appropriate off-base facility for proper disposal. The Contractor is also responsible for restoring contaminated site to pre-spill conditions.

4) If unexpected pre-existing PCS is encountered while digging or excavating for the project, the Contractor will contact the Contracting Officer and 319 CES/CEIE for guidance.

5) For spills not petroleum related, contractor will control, contain, and appropriately clean-up the spill site IAW the material SDS. Waste materials must be disposed of off base at an appropriate facility. All cleanup and site restoration is at the Contractors expense. The Contractor is responsible for restoring spill site to pre-existing conditions.

6) Appropriately stocked spill kits will be on-site and readily available where the potential spill(s) may occur.

7) The contractor will notify and provide complete documentation of spills to the CO and 319 CES/CEIE. Documentation will include the date and time of spill, location, quantity, and the material SDS. 319 CES/CEIE will file any required reports with Federal, State, and local agencies.

8) Contractor and all subcontractors will follow all federal, state, local, and GFAFB regulations and policies not directly mentioned above or in the specification. Periodic and random inspections of the project will be made by 319 CES/CEIE. Noncompliance issues will be noted to the CO. Severity of noncompliance and timeframe to rectify will be at the discretion of 319 CES/CEIE and the CO.

TABLE COMPLETION INSTRUCTIONS:

Column **1) Potential Spill Sources:** Some typical spill sources are listed, but add those materials that will be job specific and on-site during the project.

2) Prevention Method: Describe what methods you will use to prevent a spill (e.g. bulk storage of fuel in double-walled containers, 55 gallon drums of stuff stored on spill pallets, etc). For some materials, like hydraulic oil in construction equipment, daily inspection of equipment and reservoirs will be the prevention method. If hydraulic oil will be stored in bulk containers on-site, a prevention method could be "stored on spill pallets or pans inside the job trailer".

3) Control and Cleanup Measures: Describe how you will control a spill and clean it up. Consult the SDS for guidance.

4) SDS On-Site: Circle the appropriate response.

1) POTENTIAL SPILL SOURCES	2) PREVENTION MEASURES	3) CONTROL and CLEANUP MEASURES	4) MSDS On-Site
Diesel:			**YES / NO**
Gasoline:			**YES / NO**
Solvents:			**YES / NO**
Glues:			**YES / NO**
Hydraulic Fluid:			**YES / NO**
Tranny Fluid:			**YES / NO**
Paint:			**YES / NO**
Antifreeze:			**YES / NO**
			YES / NO
			YES / NO
			YES / NO
			YES / NO
			YES / NO
			YES / NO
			YES / NO
			YES / NO
			YES / NO

SECTION 01 11 00
SUMMARY OF THE WORK

A. GENERAL

WORK UNDER THIS CONTRACT

This includes all material, labor, tools, expendable equipment, utility and transportation services, and all incidental items necessary to perform and complete, in a workmanlike manner, the work required for the Combined Construction, including General, Mechanical, and Electrical Work for the project as described in the Drawings and Project Manual.

Rooms 109, 110, 111, 111A, 111B and 112 are part of a controlled area, which can be upgraded to a restricted area at Government direction. Contractor shall provide Government-approved security escorts while performing the work of this Contract in these rooms.

WORK PERFORMED BY OTHERS (N.I.C.)

Contractor shall provide access for work to be performed by Others, and shall assist in coordinating their work schedule with the project schedule. Contractor shall endeavor to ascertain that any coordination required to allow Others to properly install their work takes place in a timely manner so as to not cause a problem with the schedule or sequence of construction.

Work to be performed under separate Contracts (N.I.C.):

- Furniture
- Furnishings (except as shown on the Drawings)
- Trash Receptacles
- Office supplies and equipment
- Miscellaneous shelving and cabinets not specifically included as Architectural Casework on the Drawings or in the Specifications
- UPS systems and equipment
- Communications racks
- Fiber distribution centers
- Security cameras, equipment and monitors, rough-in boxes, conduit and wiring
- Security alarm system, rough-in boxes, conduit and wiring
- Telephone system and equipment, rough-in boxes, conduit and cabling
- Computer system, including PDU equipment, rough-in boxes, conduit and cabling
- Technical and special equipment not specified hereinafter
- Other items so noted on the Drawings or specified hereinafter

GOVERNMENT-FURNISHED/CONTRACTOR-INSTALLED (GFCI) ITEMS

The following items will be furnished by the Government, and installed under this Combined Contract:

- Certain generator fuel tank items as shown on the Drawings.
- Other items as noted on the Drawings.

REMOVED ITEMS

Items to be removed by the Contractor and reinstalled by him under this Contract are as noted in Section 02 41 00.

Items to be removed by the Contractor but to remain the property of the Government are as noted in Section 02 41 00.

Existing items to be removed or relocated by the Government are as noted in Section 02 41 00.

VERIFICATION

Prior to commencement of work, verify all existing conditions, control points, principal lines and elevations, and all adjacent facilities upon which work is in any way dependent. In the event of any inconsistency or conflict between existing conditions and the bidding documents, immediate notice of such inconsistency or conflict shall be given to the Contracting Officer. Do not undertake any work affected by such inconsistency or conflict, pending the issuance of instructions by the Contracting Officer.

Elevations of existing grades, floors, tops of walls, roof edges, beams and locations of existing columns, walls and similar items are based on drawings of the existing building furnished by the Government. The Government assumes no responsibility for the accuracy of the information on existing drawings. It is the intent of the Contract Drawings to integrate new work with existing work, and the Contractor shall verify actual conditions in the field.

PROTECTION

Provide protections necessary to prevent damage to existing buildings, finishes, improvements, landscaping and trees, parking, streets, walks, etc. to remain in place. Restore damaged buildings, finishes, improvements, etc. to their original conditions as acceptable to the Government Construction Representative.

SECTION 01 14 00
COORDINATION

A. GENERAL

DESCRIPTION

Coordination, scheduling, submittals, and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.

MEETINGS

In addition to Coordination procedures specified in Section 01000, hold Coordination Meetings and Pre-Installation Conferences with personnel and subcontractors to assure coordination of Work.

GENERAL COORDINATION

Coordinate all portions of the Work under the Contract. Require subcontractors to coordinate their portion of the Work and provide their requirements for coordination of their work with other related Work.

Coordinate mechanical and electrical Work with that of other trades in order that various components of systems are installed at proper time, fit available space, and allow proper service access to those requiring maintenance, including equipment specified in other Divisions.

Coordinate use of project space and sequence of installation of mechanical, plumbing, and electrical work, which is indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

Coordinate Work of Sections having interdependent responsibilities for installing, connecting to, and placing in service, such as equipment.

Remove and relocate items which are installed without regard to proper physical access at no additional cost to the Government.

COORDINATION OF SUBMITTALS

Schedule and coordinate submittals specified in Section 01000.

Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such as equipment.

Coordinate requests for substitutions to assure compatibility of space, of operating elements, and affect on Work of other Sections.

COORDINATION OF SPACE

Coordinate use of Project space and sequence installation of mechanical and electrical work which is indicated diagrammatically on the Drawings. Follow routings shown for pipes, ducts and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, maintenance and repairs.

In finished areas except as otherwise shown, conceal pipes, ducts and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.

COORDINATION OF CONTRACT CLOSE-OUT

Coordinate completion and cleanup of Work of separate Sections in preparation for Substantial Completion of portions of Work designated for partial occupancy by the Government.

After Government occupancy of premises, coordinate access to site by various Sections for correction of defective work and work not in accordance with Contract Documents to minimize disruption of Government activities.

Assemble and coordinate closeout submittals specified in Sections 01000 and 01 78 00.

SECTION 01 19 00
DEFINITIONS AND STANDARDS

A. GENERAL

DESCRIPTION OF WORK REQUIREMENTS

General: This Section specifies procedural and administrative requirements for compliance with governing regulations and codes and standards imposed upon the Work. These requirements include the obtaining of permits, licenses, inspections, releases, and similar statements, as well as payments, associated with regulations, codes, and standards.

"Regulations" is defined to include laws, statutes, ordinances, and lawful orders issued by governing authorities, as well as those rules, conventions and agreements within the construction industry which effectively control the performance of the Work regardless of whether they are lawfully imposed by governing authority or not.

DEFINITIONS

General Explanation: A substantial amount of Specification language consists of definitions of terms found in other Contract Documents, including the Drawings. (Drawings are recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon.) Certain terms used in Contract Documents are defined in this Article. Definitions and explanations contained in this Section are not necessarily either complete or exclusive, but are general for the Work to the extent that they are not stated more explicitly in another element of Contract Documents. In the event that the Cotnractor is uncertain as to the meaning of a term, the Contractor is responsible for requesting clarification from the Government.

General Requirements: The provisions or requirements of Division 1 Sections apply to entire Work of the Contract and where indicated, to other elements which are included in the Project.

Indicated: The term "Indicated" is a cross-reference to graphic representations, notes or schedules in the drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in Contract Documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for the purpose of helping the reader locate the cross-reference, and no limitation of location is intended except as specifically noted.

Project Site: The term "Project Site" is defined as the space available to the Contractor for performance of the Work, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the project site is shown on the drawings, and may or may not be identical with the description of the land upon which the project is to be built. Access and extent of site to be coordinated with the Government Construction Representative.

Furnish: Except as otherwise defined in greater detail, the term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., and similar operations", as applicable in each instance.

Install: Except as otherwise defined in greater detail, the term "install" as used to describe operations at project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations, as applicable in each instance.

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

Installer: The term "installer" is defined as "the entity" (person or firm) engaged by the Contractor, its subcontractor or sub-subcontractor for performance of a particular unit of work at project site, including installation, erection, application, and similar required operations. It is a requirement that installers are experienced in operations they are engaged to perform.

Testing Laboratory: The term "Testing Laboratory" is defined as an independent entity engaged to perform specific inspections or tests of the Work, either at the project site or elsewhere, and to report, and (if required) interpret results of those inspections or tests.

INDUSTRY STANDARDS

Applicability of Standards: Except where more explicit or stringent requirements are written into the Contract Documents, applicable construction industry standards have the same force and effect as if bound into or copied directly into the Contract Documents. Such industry standards are made a part of the Contract Documents by reference. Individual Specification Sections indicate which codes and standards the Contractor must keep available at the project site for reference.

Conflicting Requirements: Where compliance with two or more standards is specified, and where these standards establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents specifically indicate a less stringent requirement. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Contracting Officer for a decision before proceeding.

Minimum Quantities or Quality Levels: In every instance the quantity or quality level shown or specified is intended to be the minimum for the work to be provided or performed. Unless otherwise indicated, the actual work may either comply exactly, within specified tolerances, with the minimum quantity or quality specified, or may exceed that minimum within reasonable limits. In complying with these requirements, the indicated numeric values are either minimum or maximum values, as noted, or as appropriate for context of the requirements. Refer instances of uncertainty to the Contracting Officer for decision before proceeding.

SUBMITTALS

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

SECTION 01 32 16

CONSTRUCTION PROGRESS DOCUMENTATION
04/06

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01000 TECHNICAL PROVISIONS:

Preconstruction Submittals

Construction schedule

1.2 CONSTRUCTION SCHEDULE

Prior to the start of work, prepare and submit to the Contracting Officer for acceptance a construction schedule in the form of a Critical Path Method (CPM), Network Schedule in accordance with the terms in Contract Clause "FAR 52.236-15, Schedules for Construction Contracts," except as modified in this contract.

1.3 EQUIPMENT DELIVERY SCHEDULE

1.3.1 Initial Schedule

Within 30 calendar days after acceptance of the proposed construction schedule, submit for Contracting Officer acceptance a schedule showing procurement plans for materials and equipment. Submit in the format and content as prescribed by the Contracting Officer, and include as a minimum the following information:

a. Description.

b. Date of the purchase order.

c. Promised shipping date.

d. Name of the manufacturer or supplier.

e. Date delivery is expected.

f. Date the material or equipment is required, according to the current construction schedule.

1.4 NETWORK ANALYSIS SCHEDULE (NAS)

The Contractor shall use the critical path method (CPM) to schedule and control construction activities. The Network shall have a minimum of 20 construction activities. The scheduling software that will be utilized by the Government on this project is SureTrak by Primavera Systems, Inc. Notwithstanding any other provision in the contract, schedules submitted for this project must be prepared using either Primavera P3 or Primavera SureTrak (files saved in Concentric P3 format). Submission of data from another software system where data conversion techniques or software is used to import into Primavera's scheduling software is not acceptable and

will be cause for rejection of the submitted schedule. The schedule shall identify as a minimum:

a. Construction time for all major systems and components;

b. Each activity shall be assigned its appropriate Responsibility Code;

c. Each activity shall be assigned its appropriate Phase Code;

d. Major submittals and submittal processing time; and

e. Major equipment lead time.

1.4.1 CPM Submittals and Procedures

Submit all network analysis and updates in hard copy. The network analysis system shall be kept current, with changes made to reflect the actual progress and status of the construction.

1.5 UPDATED SCHEDULES

Update the construction schedule and equipment delivery schedule at monthly intervals or when the schedule has been revised. Reflect any changes occurring since the last update. Submit copies of the purchase orders and confirmation of the delivery dates as directed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.
-- End of Section --

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32	(2004) Fall Protection
ASSE/SAFE A10.34	(2001; R 2005) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.22	(2005) Articulating Boom Cranes
ASME B30.3	(2004) Construction Tower Cranes
ASME B30.5	(2004) Mobile and Locomotive Cranes
ASME B30.8	(2004) Floating Cranes and Floating Derricks

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA NPG 8621.1	(2004a) NASA Mishap Reporting, Investigating and Record Keeping Policy
NASA NPG 8715.3	(2004) NASA Safety Manual
NASA NSS 1740.12	(1993) NASA Safety Standard For Explosives, Propellants and Pyrotechnics

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2006; Errata 2006) Standard for Portable Fire Extinguishers
NFPA 241	(2004) Safeguarding Construction,Alteration, and Demolition Operations
NFPA 70	(2007) National Electrical Code - 2008 Edition
NFPA 70E	(2004; AMD 2004) Electrical Safety in the

Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety -- Safety and Health Requirements

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.500	Fall Protection

1.2 SUBMITTALS

Submit the following in accordance with Section 01000 TECHNICAL PROVISIONS:

Preconstruction Submittals

Accident Prevention Plan (APP)

Activity Hazard Analysis (AHA)

Test Reports

Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Accident Reports
Monthly Exposure Reports

Certificates

Confined Space Entry Permit

Contractor Safety Self-Evaluation Checklist

1.3 DEFINITIONS

a. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.

b. High Visibility Accident. Any mishap which may generate publicity and/or high visibility.

c. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

d. Qualified Person for Fall Protection. A person with a recognized degree or professional certificate, and with extensive knowledge, training and experience in the field of fall protection; who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.

e. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

(1) Death, regardless of the time between the injury and death, or the length of the illness;

(2) Days away from work (any time lost after day of injury/illness onset);

(3) Restricted work;

(4) Transfer to another job;

(5) Medical treatment beyond first aid;

(6) Loss of consciousness; or

(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

f. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.

1.4 CONTRACTOR SAFETY SELF-EVALUATION CHECKLIST

Contracting Officer will provide a "Contractor Safety Self-Evaluation checklist" to the Contractor at the pre-construction conference. The checklist will be completed monthly by the Contractor and submitted with each request for payment voucher. An acceptable score of 90 or greater is required. Failure to submit the completed safety self-evaluation checklist or achieve a score of at least 90, will result in a retention of up to 10 percent of the voucher.

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with USACE EM 385-1-1, and the following federal, state, and local, laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.6 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

Provide a site Safety and Health Officer (SSHO) at the work site at all times to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The Contractor Quality Control (QC) person can be the SSHO on this project. Meet the following requirements within the SSHO:

Level 1:
Worked on similar projects.
10-hour OSHA construction safety class or equivalent within last 3 years.
Competent person training as needed.

1.6.1.2 Competent Person for Confined Space Entry

Provide a competent person for confined space meeting the definition and requirements of EM 385-1-1.

1.6.2 Personnel Duties

1.6.2.1 Site Safety and Health Officer (SSHO)

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily quality control report.

b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.

c. Maintain applicable safety reference material on the job site.

d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted APPS and AHAs.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

Failure to perform the above duties will result in dismissal of the superintendent and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.6.3 Meetings

1.6.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.6.3.2 Safety Meetings

Conduct and documente meetings as required by EM 385-1-1. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the Contractors' daily quality control report.

1.7 ACCIDENT PREVENTION PLAN (APP)

Use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan" and show compliance with NASA NPG 8715.3. Specific requirements for some of the APP elements are described below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer and any designated CSP and/or CIH.

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed

without an accepted APP.

Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any hazard become evident, stop work in the area, secure the area, and develop a plan to remove the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the Contracting Officer's office and at the job site. Continuously reviewed and amended the APP, as necessary, throughout the life of the contract. Incorperate unusual or high-hazard activities not identified in the original APP as they are discovered.

1.7.1 EM 385-1-1 Contents

In addition to the requirements outlines in Appendix A of USACE EM 385-1-1, the following is required:

a. Names and qualifications (resumes including education, training, experience and certifications) of all site safety and health personnel designated to perform work on this project to include the designated site safety and health officer and other competent and qualified personnel to be used such as CSPs, CIHs, STSs, CHSTs. Specify the duties of each position.

b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons for each of the following major areas: excavation; scaffolding; fall protection; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; personal protective equipment and clothing to include selection, use and maintenance.

c. Confined Space Entry Plan. Develop a confined space entry plan in accordance with USACE EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

1.8 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1. Submit the AHA for review at least 15 calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP.

The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer.

1.9 DISPLAY OF SAFETY INFORMATION

Within 1 calendar day after commencement of work, erect a safety bulletin board at the job site. Include and maintain information on safety bulletin board as required by EM 385-1-1, section 01.A.06. Additional items required to be posted include:

a. Confined space entry permit.

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.12 REPORTS

1.12.1 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, and property damage accidents resulting in at least $2,000 in damages, to establish the root cause(s) of the accident, complete the Navy Contractor Significant Incident Report (CSIR) formUSACE Accident Report Form 3394 and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

1.12.2 Accident Notification

Notify the Contracting Officer as soon as practical, but not later than four hours, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident in accordance with NASA NPG 8621.1. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site

and Government investigation is conducted.

1.12.3 Monthly Exposure Reports

Monthly exposure reporting to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. The Contracting Officer will provide copies of any special forms.

1.13 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer.

1.14 GAS PROTECTION

Contractor shall have one or more employees properly trained in operation of gas testing equipment and formally qualified as gas inspectors who shall be on duty during times workmen are in confined spaces. Their primary functions shall be to test for gas and operate testing equipment. Unless equipment of constant supervisory type with automatic alarm is employed, gas tests shall be made at least every 2 hours or more often when character of ground or experience indicates gas may be encountered. A gas test shall be made before workmen are permitted to enter the excavation after an idle period exceeding one-half hour.

Readings shall be permanently recorded daily, indicating the concentration of gas, point of test, and time of test. Submit copies of the gas test readings to the Contracting Officer at the end of each work day.

Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. A check by Government is required prior to entering confined space. Surveillance and monitoring shall be required in these types of work spaces by both Contractor and Government personnel.

1.15 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and explosive device activated tools) shall be scheduled during the hours of 0900 to 1500, Mondays thru Fridays. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work.

1.16 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or

against existing facilities.

c. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS

Not used.

2.1 CONFINED SPACE SIGNAGE

Provide permanent signs integral to or securely attached to access covers for new permit-required confined spaces. Signs wording: "DANGER--PERMIT-REQUIRED CONFINED SPACE - DO NOT ENTER -" in bold letters a minimum of one inch in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" shall be red and readable from 5 feet.

2.2 FALL PROTECTION ANCHORAGE

Leave in place fall protection anchorage, conforming to ASSE/SAFE Z359.1, installed under the supervision of a qualified person in fall protection, for continued customer use and so identified by signage stating the capacity of the anchorage (strength and number of persons who may be tied-off to it at any one time).

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

Comply with USACE EM 385-1-1, NFPA 241, the APP, the AHA, Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

3.1.1 Hazardous Material Use

Each hazardous material must receive approval prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material.

3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.

3.1.3 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos. If material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting

Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least 15 days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the Contracting Officer and the Installation representative to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 SAFETY LOCKOUT/TAGOUT PROCEDURES

Contractor shall ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147.

Contracting Officer will, at the Contractor's request, apply lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section.

No person shall work on any equipment that requires a lockout/tagout tag unless he, his immediate supervisor, project leader, or a subordinate has in his possession the stubs of the required lockout/tagout tags.

When work is to be performed on electrical circuits, only qualified personnel shall perform work on electrical circuits.

A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

3.3.1 Tag Placement

Lockout/tagout tags shall be completed in accordance with the regulations printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist.

If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of lockout/tagout tags completed and properly attached.

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

3.3.2 Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the Contracting Officer. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the Contracting Officer.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protectionin accordance with USACE EM 385-1-1, section 21.A.16.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, paragraphs 05.H. and 05.I. Personal fall arrest systems are required when working

from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.4.3 Existing Anchorage

Certified (or re-certified) by a qualified person for fall protection existing anchorages, to be used for attachment of personal fall arrest equipment in accordance with ASSE/SAFE Z359.1. Exiting horizontal lifeline anchorages must be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.4.4 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.4.5 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

3.4.6 Rescue and Evacuation Procedures

When personal fall arrest systems are used, the contractor must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.5 EQUIPMENT

3.5.1 Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.5.2 Weight Handling Equipment

a. Equip cranes and derricks as specified in EM 385-1-1, section 16.

b. Notify the Contracting Officer 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Prior to cranes entering federal activities, a Crane Access Permit must be obtained from the Contracting Officer. A copy of the permitting process will be provided at the Preconstruction Conference. Contractor's operator shall remain with the crane during the spot check.

c. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

d. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

e. Under no circumstance shall a Contractor make a lift at or above 90% of the cranes rated capacity in any configuration.

f. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of USACE EM 385-1-1 section 11 and ASME B30.5 or ASME B30.22 as applicable.

g. Do not crane suspend personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

h. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

i. All employees must keep clear of loads about to be lifted and of suspended loads.

j. Use cribbing when performing lifts on outriggers.

k. The crane hook/block must be positioned directly over the load.

Side loading of the crane is prohibited.

l. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

m. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.

n. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

o. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

p. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. Prior to conducting lifting operations set a maximum wind speed at which a crane can be safely operated based on the equipment being used, the load being lifted, experience of operators and riggers, and hazards on the work site. This maximum wind speed determination shall be included as part of the activity hazard analysis plan for that operation.

3.5.3 Equipment and Mechanized Equipment

a. Proof of qualifications for operator shall be kept on the project site for review.

b. Manufacture specifications or owner's manual for the equipment shall be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorperate such additional safety precautions or requirements into the AHAs.

3.5.4 USE OF EXPLOSIVES

Ezplosives shall not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

Explosive work shall be performed in accordance with NASA NSS 1740.12. This document is available at:

http://www.hq.nasa.gov/office/codeq/doctree/871912.htm

3.6 EXCAVATIONS

Perform soil classification by a competent person in accordance with 29 CFR 1926.

3.6.1 Utility Locations

Prior to digging, the appropriate digging permit must be obtained. All underground utilities in the work area must be positively identified by a private utility locating service in addition to any station locating service and coordinated with the station utility department. Any markings made during the utility investigation must be maintained throughout the contract.

3.6.2 Utility Location Verification

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 2 feet of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility expose the utility by hand digging every 30.5 m (100 feet) if parallel within 1.5 m (5 feet) of the excavation.

3.6.3 Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacture tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding must have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

3.6.4 Trenching Machinery

Operate trenching machines with digging chain drives only when the spotters/laborers are in plain view of the operator. Provide operator and spotters/laborers training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Keep documentation of the training on file at the project site.

3.7 ELECTRICAL

3.7.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Contracting Officer and Station Utilities for identification. The Contracting Officer will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers will be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective

equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

3.7.2 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Iimmediately removed from service all damaged extension cords. Portable extension cords shall meet the requirements of NFPA 70.

3.8 WORK IN CONFINED SPACES

Comply with the requirements in Section 06.I of USACE EM 385-1-1, OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6). Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 06.I.06 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

-- End of Section --

SECTION 01 40 00
TESTING LABORATORY SERVICES

A. GENERAL

REQUIREMENTS INCLUDED

Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform testing and services specified in this Section.

Where terms “Inspector” and “Testing Laboratory” are used, they mean and refer respectively to an officially designated and accredited Inspector of the Testing Laboratory and the Testing Laboratory employed on behalf of the Government.

Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities.

QUALIFICATION OF LABORATORY

Shall meet “Recommended Requirements for Independent Laboratory Qualification” published by the American Council of Laboratories. Shall meet basic requirements of ASTM E 329, “Standards of Recommended Practices for Inspection and Testing Agencies for Concrete and Steel as Used in Construction”. Shall be authorized to operate in the State in which the Project is located.

Testing equipment shall be calibrated at reasonable intervals by devices of accuracy traceable to either:
A. National Bureau of Standards
B. Accepted value of natural physical conditions.

LABORATORY DUTIES AND RESPONSIBILITIES

Cooperate with Contracting Officer, Government Construction Representative and Contractor; provide qualified personnel after due notice.

Perform specified inspections, sampling and testing of materials and methods of construction.

Ascertain compliance of materials with requirements of Contract Documents.

Furnish Contracting Officer with written evaluation of proposed concrete design mixes, and other material sizes, submitted by General Contractor for evaluation.

Notify Contracting Officer and General Contractor immediately of observed work or materials which fail to meet the requirements of Contract Documents.

Promptly submit written report of each test and inspection; distribution will be at a minimum to Contracting Officer and General Contractor and as designated by Contracting Officer. Each report shall include:
A. Date issued.
B. Project title and number.
C. Testing Laboratory.
D. Name and signature of Laboratory inspector.
E. Date and time of sampling or inspection.
F. Record of temperature and weather conditions.
G. Date of tests.
H. Identification of products and Specification Section.
I. Location of sample of test in the Project.
J. Type of inspection.
K. Results of tests and compliance with Contract Documents.
L. Interpretation of test reports, when requested by Contracting Officer.

Perform additional tests as required by the Contracting Officer.

LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

Laboratory is not authorized to:

A. Release, revoke, alter or enlarge on requirements of Contract Documents.
B. Approve or accept any portion of the Work.
C. Perform any duties of the Contractor.

Work will be checked as it progresses, but failure to detect any defective work or materials shall not, in any way, prevent later rejection when such defect is discovered.

CONTRACTOR'S RESPONSIBILITIES

Cooperate with Laboratory personnel, provide access to Work and to manufacturer's operations.

Secure and deliver to the Laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.

Furnish the Laboratory with proposed concrete design mixes, and other material mixes which require evaluation by the Testing Laboratory, a minimum of fourteen (14) days prior to use on the Project.

Submittals and Certification by the Testing Laboratory:

A. Submit two (2) copies to Contracting Officer and one (1) copy to General Contractor of certification of each inspection and test required.
B. In each Certificate state details of each inspection and test to indicate satisfactory compliance with requirements of each inspection

Furnish incidental labor and facilities:

A. To provide access to Work to be tested.
B. To obtain and handle samples at the project site or at the source of the product to be tested.
C. To facilitate inspections and tests.
D. For safe storage and curing of test samples.

C. EXECUTION

Requirements for testing and inspection are as follows:

1. **Reinforced Concrete**
    a. The final placement of all reinforcing steel shall be inspected and approved prior to the closing of forms and/or the delivery of concrete to the job site as described in Chapter 17 of the 2006 International Building Code.
    b. All reinforced concrete not specifically exempted below shall be inspected continuously during placing and taking of test specimens as described in Chapter 17 of the 2006 International Building Code.
        1. No special inspections are required for concrete slabs-on-grade or site work concrete fully supported on earth.

SOILS TESTING

Sampling shall be made by the Inspector's authorized representative. The location from which the sample was taken shall be noted on the Test Report.

REPORTS

Reports for concrete testing shall be distributed by the Inspector as follows:

Contracting Officer	One copy
General Contractor	One copy
Concrete Producer	One copy

Monthly reports for all other testing shall be distributed by the Inspector as follows:

Contracting Officer	One copy
General Contractor	One copy

Tests/Inspections are required for work specified in the following Sections:

03 20 00	Concrete Reinforcement
03 30 00	Cast-In-Place Concrete
Div's. 21, 22 & 23	Miscellaneous Backfill for Buried Mechanical Items
Div's. 26 & 27	Miscellaneous Backfill for Buried Electrical Items
31 10 00	Earthwork
31 10 10	Building Earthwork
32 16 13	Pavement and Walks

SECTION 01 60 00
MATERIAL AND EQUIPMENT

A. GENERAL

SUBSTITUTIONS

Material and equipment shall be of the manufacture, model, and type specified. Substitute material and equipment will be allowed as described below.

MATERIAL AND EQUIPMENT OF APPROVED MANUFACTURE

An item of material or equipment may be used in place of an item which is specified by manufacturer and model number or type, provided that all of the following provisions are met:

1. The item is manufactured by one of the acceptable manufacturers listed in the Specifications, Drawings or Addendae.
2. The item of material or equipment meets or exceeds the minimum qualities established by the specified item.
3. The item is used throughout the project so that all items of material or equipment used in place of specified items are of the same make and type.
4. The entire cost of all modifications which result from the use of items in place of specified items shall be borne by the contractor who uses such items, at no additional cost to other contractors or to the Government.

REPETITION

Repeated features or materials must be constructed alike, although detailed or indicated only once. Where items, devices, or equipment are specified singular in number, the Specification shall apply to as many items, devices, or pieces of equipment as are shown on the Drawings or required to complete the installation. Repeated items of equipment or materials shall be of the same manufacturer, model number, and type.

SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

EPA maintains a Database of Manufacturers and Suppliers for each designated item at http://www.epa.gov/cpg/database.htm. Use of sources from this database is not required. It is intended as a tool to assist purchasers in locating products with recycled content.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification for non-use is provided. The following are considered adequate justifications for non-use:

a. The product does not meet appropriate performance standards.

b. The product is not available within a reasonable time frame.

c. The product is not available competitively (from two or more sources).

d. The product is only available at an unreasonable price (compared

with a comparable non-recycled content product).

When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

-- End of Section --

SECTION 01 70 00
PROJECT CLOSEOUT

A. GENERAL

At the completion of the Work, the Contractor and all subcontractors shall clean up in accordance with Section 01000 and individual Specification Sections. Requirements for removal of construction debris from the building and site areas will be strictly enforced.

Inspection certificates issued by regulatory agencies shall be submitted to the Contracting Officer before Final Acceptance.

Operation and maintenance manuals shall be submitted to the Contracting Officer in triplicate before final payment or earlier when specified. Operation and maintenance manuals shall be bound in binders. The binders shall be 2-inch, red, vinyl-covered, three-ring binders. See Section 01000 for list of the operation and maintenance manuals required.

SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 1609	(1994; R 2001) Development and Implementation of a Pollution Prevention Program

1.2 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy the Contractor shall: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

1.3 WASTE MANAGEMENT

Develop and implement a waste management program in accordance with ASTM E 1609 and as specified. The Contractor shall take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling shall accrue to the Contractor. Firms and facilities used for recycling, reuse, and disposal shall be appropriately permitted for the intended use to the extent required by federal, state, and local regulations. The Contractor shall provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01000 TECHNICAL PROVISIONS:

Preconstruction Submittals

Waste Management Plan

1.5 MEETINGS

The Contractor shall conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, the Contractor shall schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section 01000 TECHNICAL PROVISIONS. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

b. Preconstruction meeting.

c. Regular site meetings.

1.6 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the preconstruction meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale,

salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Estimated percentage of waste diverted by this Plan. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. The Contractor shall distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.7 REPORTS

Provide quarterly reports and a final report to the Contracting Officer's Representative. Quarterly and final reports shall include project name, information for waste generated this quarter, and cumulative totals for the project. Each report shall include supporting documentation to include manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. Include timber harvest and demolition information, if any.

1.8 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations. Separate materials by one of the following methods:

1.8.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process).

1.8.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.8.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.9 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.9.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Coordinate reuse with Contracting Officer. Sale or donation of waste suitable for reuse shall be considered.

1.9.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled.

1.9.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.9.4 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

<END/>

SECTION 01 78 00

CLOSEOUT SUBMITTALS
01/08

PART 1 GENERAL
1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 1971	(2005) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMITTALS

Submit the following in accordance with Section 01000 TECHNICAL PROVISIONS:

Product Data

Warranty Management Plan

Two sets of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Closeout Submittals
Certification of EPA Designated Items
Form DD1354
Checklist for Form DD1354

1.3 PROJECT RECORD DOCUMENTS

1.3.1 Final Approved Shop Drawings

Furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.3.2 Construction Contract Specifications

Furnish final record (as-built) construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.3.3 Real Property Equipment

Furnish a list of installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of

manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Furnish a draft list at time of transfer. Furnish the final list 30 days after transfer of the completed facility.

1.4 CERTIFICATION OF EPA DESIGNATED ITEMS

Submit the Certification of EPA Designated Items as required by FAR 52.223-9, "Certification and Estimate of Percentage of Recovered Material Content for EPA Designated Items". Include on the certification form the following information: project name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor: "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials: 1) The product does not meet appropriate performance standards; 2) The product is not available within a reasonable time frame; 3) The product is not available competitively (from two or more sources); 4) The product is only available at an unreasonable price (compared with a comparable non-recycled content product)." Record each product used in the project that has a requirement or option of containing recycled content in accordance with Section 01 62 35 RECYCLED/RECOVERED MATERIALS, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, and comments. Recycled content values may be determined by weight or volume percent, but must be consistent throughout.

1.5 WARRANTY

See Section 01 78 36.00 24 WARRANTY OF CONSTRUCTION.

1.6 CLEANUP

Provide final cleaning in accordance with ASTM E 1971. Leave premises "broom clean." Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site. Recycle, salvage, and return construction and demolition waste from project in accordance with the Waste Management Plan. Promptly and legally transport and dispose of any trash. Do not burn, bury, or otherwise dispose of trash on the project site.

1.7 REAL PROPERTY RECORD

Near the completion of Project, but a minimum of 60 days prior to final acceptance of the work, complete, update draft attached to this section, and submit an accounting of all installed property on Form DD1354 "Transfer and Acceptance of Military Real Property." Contact the Contracting Officer for any project specific information necessary to complete the DD Form 1354. For information purposes, a blank DD Form 1354 (fill-able) in ADOBE (PDF) may be obtained at the following web site:
http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd1354.pdf

Submit the completed Checklist for Form DD1354 of Government-Furnished and Contractor-Furnished/Contractor Installed items. Attach this list to the updated DD Form 1354. Instructions for completing the form and a blank checklist (fill-able) in ADOBE (PDF) may be obtained at the following web site:

http://www.hnd.usace.army.mil/techinfo/UFC/UFC1-300-08/UFC1-300-08.pdf

See Appendix D of this pdf for the checklist.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

DIVISION 2 - SITEWORK

SECTION 02 01 00
SUBSURFACE EXPLORATION

Subsurface soil investigations have been made, and certain portions of the report are included at the end of this Section. A complete report of the investigations is in the office of the Contracting Officer for review if so desired. Contractors are highly encouraged to review the report prior to Bidding. The Government will not assume responsibility for variations of subsoil quality or conditions at locations other than the places shown and at the time investigations were made.

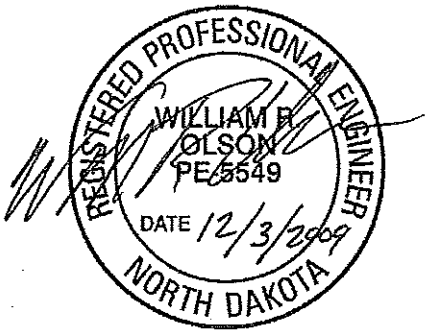
Locations and summaries of the exploratory holes, indicating types of materials and depths at which they are found for each hole, are included in this Section. Additional detail is available in the complete report at the office of the Contracting Officer.

Geotechnical Investigation Report

Proposed Addition
Building 516
Grand Forks AFB, North Dakota

Prepared for
Kenneth Hahn Architects, Inc.

December 3, 2009



MTL Project Number G4282

Midwest Testing Laboratory, Inc.
1555 N 42nd Street – Unit B
Grand Forks, ND 58203-0809
701-772-2832

Contents

Appendix

1.0 Introduction

The project will include construction of a single-story building addition with a floor slab on grade. This report presents the results of the field and laboratory testing, along with our evaluation of the test results and recommendations concerning the geotechnical aspects of the proposed addition.

1.1 Scope of Work

Our scope of work for this project is limited to the following items:

1. Perform one soil test boring to a depth of 20 feet to obtain information regarding the soil and ground water conditions in this area.

2. Perform laboratory testing to assist in classifying the soils and provide information regarding strength properties. Laboratory testing includes moisture content, dry density, unconfined compressive strength and Atterberg limits.

3. Analyze the soil conditions encountered at the site and provide recommendations regarding the geotechnical aspects of the proposed addition.

2.0 Soil Borings and Laboratory Testing

The field work consisted of completing one soil test boring and performing geotechnical laboratory analysis on representative soil samples. More specific information regarding the fieldwork and laboratory testing is discussed below.

2.1 Field Exploration

One standard penetration test boring was performed on November 23, 2009. The boring was performed at the approximate location indicated on the attached sketch.

2.1.1 Site Conditions

The proposed addition will be constructed on the south side of Building 516 located on the south side of 1st Avenue and to the west of Eielson Street at the Grand Forks Air Force Base. The site is relatively level with a surface elevation at our boring location of 98.8 referenced to our temporary benchmark.

2.1.2 Soil Conditions

Existing lean clay fill was encountered at our boring location extending to a depth of six feet. Below the fill natural, inorganic sandy lean clay was encountered extending to the termination depth of the boring (21 feet). The sandy lean clay is grayish brown mottled in coloration and is very stiff in consistency. These soils contain a trace of gravel and a few seams of sand.

This brief description of the soil conditions encountered at our boring locations is intended as a general overview. For a graphical and more complete description of the soils encountered within our boring, please refer to the attached boring logs.

2.1.3 Ground Water

Ground water was not encountered during or upon completion of our boring. In order to determine a static ground water level at this site the borings would need to be left open for an extended period of time or piezometers would need to be installed. This is beyond the scope of our investigation. Based on information available, we estimate a ground water level on the order of ten feet below existing grade. Static ground water conditions can be expected to fluctuate on a seasonal and annual basis.

With anticipated excavation depths, we do not expect the ground water level to be a concern for construction purposes at this site. In our opinion, any water encountered should be controllable by sump pumping.

2.2 Laboratory Testing

Representative samples were selected for laboratory analysis. The testing program consisted of determining moisture content, dry density, Atterberg limits and unconfined compressive strength. The laboratory test results can be found on the boring logs, opposite the samples they represent.

3.0 Analysis and Recommendations

Our analysis and recommendations are based upon the project features described below. If there are any discrepancies or changes made prior to construction, we should be notified so that we may review our recommendations in light of the actual building features.

3.1 Project Information

The proposed addition will be a single-story masonry structure with a floor slab on grade. The building will cover approximately 400 square feet and will house an emergency generator. Actual building loads were not provided. Therefore, we will assume continuous wall loads will not exceed 5 kips per lineal foot. We will assume the floor slab elevation will match that of the existing building (elevation 100.0).

3.2 Foundations

In our opinion, standard spread foundations are feasible for support of the proposed addition at this site. We recommend spread foundations obtain bearing on natural, inorganic, undisturbed soils or upon a well-compacted engineered fill after removal of the existing fill. We recommend exterior footings be supported at a depth that will provide adequate frost protection. For the Grand Forks area, we recommend spread footings obtain bearing at least five feet below final exterior grade for heated buildings. Interior footings in heated areas may be supported at a convenient depth below the floor slab, provided that all topsoil is removed and replaced with a well-compacted engineered fill.

We recommend excavating the existing fill from below the proposed building area. The test boring indicates an excavation depth on the order of six feet below existing grade would be needed. The excavation should be oversized horizontally at least one foot beyond the outer edge of the footing for each two feet of engineered fill below footing elevation. We recommend the foundation excavations be observed at the time of construction by a geotechnical engineer or his representative prior to the placement of concrete or engineered fill. Engineered fill, consisting of a relatively clean, inorganic pit run sand and gravel, should then be used to obtain the desired footing and floor elevation. The engineered fill should be placed in loose lifts of 12 inches or less and compacted to a minimum of 100 percent of the Standard Proctor maximum density (ASTM D698).

Based on the standard penetration resistance values, laboratory test results, and our past experience with similar soils, we recommend a maximum allowable soil bearing pressure of 4000 pounds per square foot (psf) for design of spread footings. We estimate a foundation loading of this magnitude will have a theoretical factor of safety of 3 with respect to shear failure and detrimental settlement should not occur.

3.3 Floor Slab

We recommend excavating the existing fill from areas to receive floor slabs. The test boring indicates an excavation depth on the order of six feet below existing grade will be needed. The excavation should be closely observed at the time of construction to determine the proper amount of excavation needed to remove the fill. To raise the building area to the desired floor slab level, we recommend an inorganic, relatively clean, pit run sand and gravel. We recommend all engineered fill below floor areas be compacted in loose lifts of 12 inches or less to a minimum of 95 percent of the Standard Proctor maximum density (ASTM D 698).

Directly beneath floor slabs, we recommend providing at least six inches of a free draining coarse sand or gravel with less than five percent passing the number 200 sieve. This clean sand or gravel layer should be provided to guard against wetting of the floor slab due to the underlying soils.

3.4 Exterior Backfill

Inorganic soils excavated from the building area may be used as exterior foundation backfill. Sidewalks and pavements supported on clay soils will be subjected to movement from frost action. In grass areas, we recommend placing the backfill in six-inch lifts and compacting to a minimum of 90 percent of the Standard Proctor maximum density (ASTM D698). Exterior backfill used to support sidewalks or pavements should be compacted to a minimum of 95 percent. Final exterior grading should provide permanent and positive drainage away from the building.

4.0 Field Investigation Procedures

One soil test boring was performed at the site on November 23, 2009. The approximate boring location is indicated on the attached sketch. The surface elevations provided on the boring log is referenced to the finished floor of the existing building as indicated on the attached sketch. This was assumed to be at elevation 100.0.

4.1 Soil Sampling

The boring was advanced with 3¼ inch hollow stem auger, with split barrel samples obtained in accordance with ASTM D1586. Using this procedure, a two-inch O.D. split barrel sampler is driven by a 140-pound weight falling 30 inches. The number of blows required to drive the sampler twelve inches after a six inch initial set is the standard penetration resistance and will be referred to as N value, an index related to the consistency of cohesive soils and the relative density of cohesionless soils.

4.2 Soil Classifications

As the boring was advanced in the field and samples obtained, they were visually and manually classified in accordance with ASTM D2488. Representative portions of all samples were returned to the laboratory for review of the field classifications. Selected samples were submitted to a program of laboratory tests to aid in determining the characteristics of the soil. Logs of the boring, laboratory test results and charts illustrating the soil classification procedures and descriptive terminology are attached.

5.0 Limitations

5.1 Review of Plans and Specifications

A number of assumptions were made to develop this geotechnical report. If revisions are made which differ from the assumptions stated in this report, Midwest Testing Laboratory, Inc. should be notified to determine if the changes will affect our recommendations. Also, when plans and specifications are complete, the geotechnical engineer should be retained to review this information and determine that our recommendations have been properly applied to the project documents. These recommendations may not be applied to other projects.

5.2 Construction Testing Services

Since we are most familiar with the geotechnical aspects of the project, we recommend Midwest Testing Laboratory, Inc. be retained to perform all soil observations and testing during construction. We are not responsible for interpretations or changes to the recommendations made by others.

5.3 Standard of Care

The area of the borings in relation to the entire site is relatively small and therefore, should not be assumed to be necessarily typical of the entire area of the site. Also, this investigation cannot represent soil conditions below the depths of our borings. Because of these and other reasons, we recommend close observation during construction for soil conditions not typical of the strata logged.

This work was performed using the degree of care and skill according to currently accepted engineering practices at this time and location. No other warranty is intended or implied.

MIDWEST TESTING LABORATORY

JOB NO.: G4282 LOG OR TEST BORING NO.: 1 VERTICAL SCALE: 1"=3'

PROJECT: Proposed Addition, Building 516, Grand Forks Air Force Base, North Dakota

DEPTH IN FEET	SOIL DESCRIPTION SURFACE ELEVATION: 98.8	SAMPLE NO.	SAMPLE TYPE	N VALUE	LABORATORY TESTS MOISTURE	DENSITY	LL/PL	Qu
	FILL – LEAN CLAY – dark grayish brown and brown, with a trace of sand and gravel	1	SS	16				
		2	SS	16				
6		3	SS	7				
	SANDY LEAN CLAY – grayish brown mottled, very stiff, with a trace of gravel and a few seams of sand (CL)	4	TW		20.5	106.5	37/23	4900
		5	SS	19				
		6	SS	19	21.3			
		7	SS	19				
		8	SS	20	22.5			
21	End of Boring							

WATER LEVEL DATA

DATE	TIME	CAVE IN DEPTH	WATER LEVEL
11-23-09	9:36	HSA 19½'	None
11-23-09	9:41	10.0'	None

BORING DATA

STARTED: 11-23-09 COMPLETED: 11-23-09 @ 9:36

METHOD USED: 3¼" HSA 0-19½'

CREW CHIEF: T. Messelt

Classification of Soils For Engineering Purposes

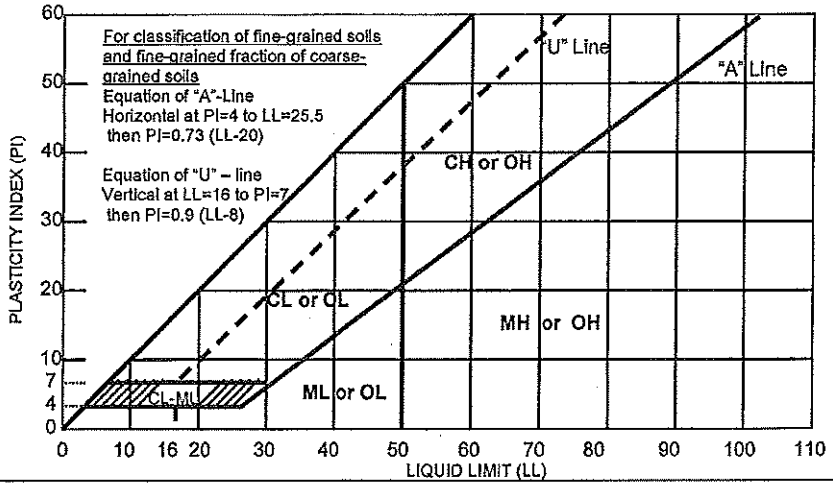
ASTM:D 2487-00

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 Sieve	Gravels More than 50% coarse fraction retained on No. 4 Sieve	Clean Gravels Less than 5% fines[C]	Cu≥4 and 1≤Cc≤ 3[E]	GW	Well graded gravel[F]
			Cu<4 and/or 1>Cc>3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 Sieve	Clean Sands Less than 5% fines[D]	Cu≥6 and 1≤Cc≤3[E]	SW	Well-graded sand[I]
			Cu<6 and/or 1>Cc>3[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 Sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI> 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI<4 or plots below "A" line[J]	ML	Silt[K,L,M]
		Organic	Liquid limit - oven dried / Liquid limit - not dried <0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		Organic	Liquid limit - oven dried / Liquid limit - not dried <0.75	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,Q]
Highly organic soils	Primary organic matter, dark in color, and organic odor			PT	Peat
Fibric Peat > 67% Fiber	Hemic Peat 33%-67% Fibers				Sapric Peat < 33% Fibers

[A]Based on the material passing the 3-in. (75mm) sieve.
[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C]Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
[D]Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E]$Cu = D_{60} / D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to group name.
[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H]If fines, are organic, add " with organic fines" to group name.
[I]If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J]If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
[K]If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
[L]If soil contains ≥ 30% plus no. 200, predominantly sand, add "sandy" to group name.
[M]If soil contains ≥ 30% plus no. 200, predominantly gravel, add "gravelly" to group name.
[N]PI≥ 4 and plots on or above "A" line.
[O]PI<4 or plots below "A" line.
[P]PI plots on or above "A" line.
[Q]PI plots below "A" line.



DESCRIPTIVE TERMINOLOGY

RELATIVE DENSITY

Term	"N" Value
Very Loose	0-4
Loose	5 – 9
Medium Dense	10 – 30
Dense	31 – 50
Very Dense	Greater than 50

THICKNESS OF SOIL INTRUSIONS

Term	Range
Lense / Lamination	0 – 1/8"
Seam	1/8" – 1"
Layer	1" – 12"

CONSISTENCY OF COHESIVE SOILS

Term	"N" Value
Very soft	Less than 2
Soft	2 – 4
Medium stiff	5 – 8
Stiff	9 – 15
Very Stiff	16 – 30
Hard	Greater than 30

RELATIVE PROPORTIONS

Term	Range
Trace	0 – 5%
A Little	5 – 15%
With	15 – 50%

PARTICLES SIZES

Term	Range
Boulders	Over 12"
Cobbles	3"– 12"
Gravel	
Coarse	3/4" – 3"
Fine	#4 – 3/4"
Sand	
Coarse	#4 - #10
Medium	#10 - #40
Fine	#40 - #200
Silt	#200 – 0.005 mm
Clay	Less than 0.005 mm

Note: Sieve sizes shown are U.S. Standard

DRILLING & SAMPLING SYMBOLS

Symbol	Definition
FA	Flight Auger
SS	Split Spoon
TW	Thin-Walled Tube
HSA	Hollow Stem Auger
N	Penetration Resistance: blows required to drive a two-inch OD split spoon sampler one foot by means of a 140-pound hammer falling 30 inches

LABORATORY TEST SYMBOLS

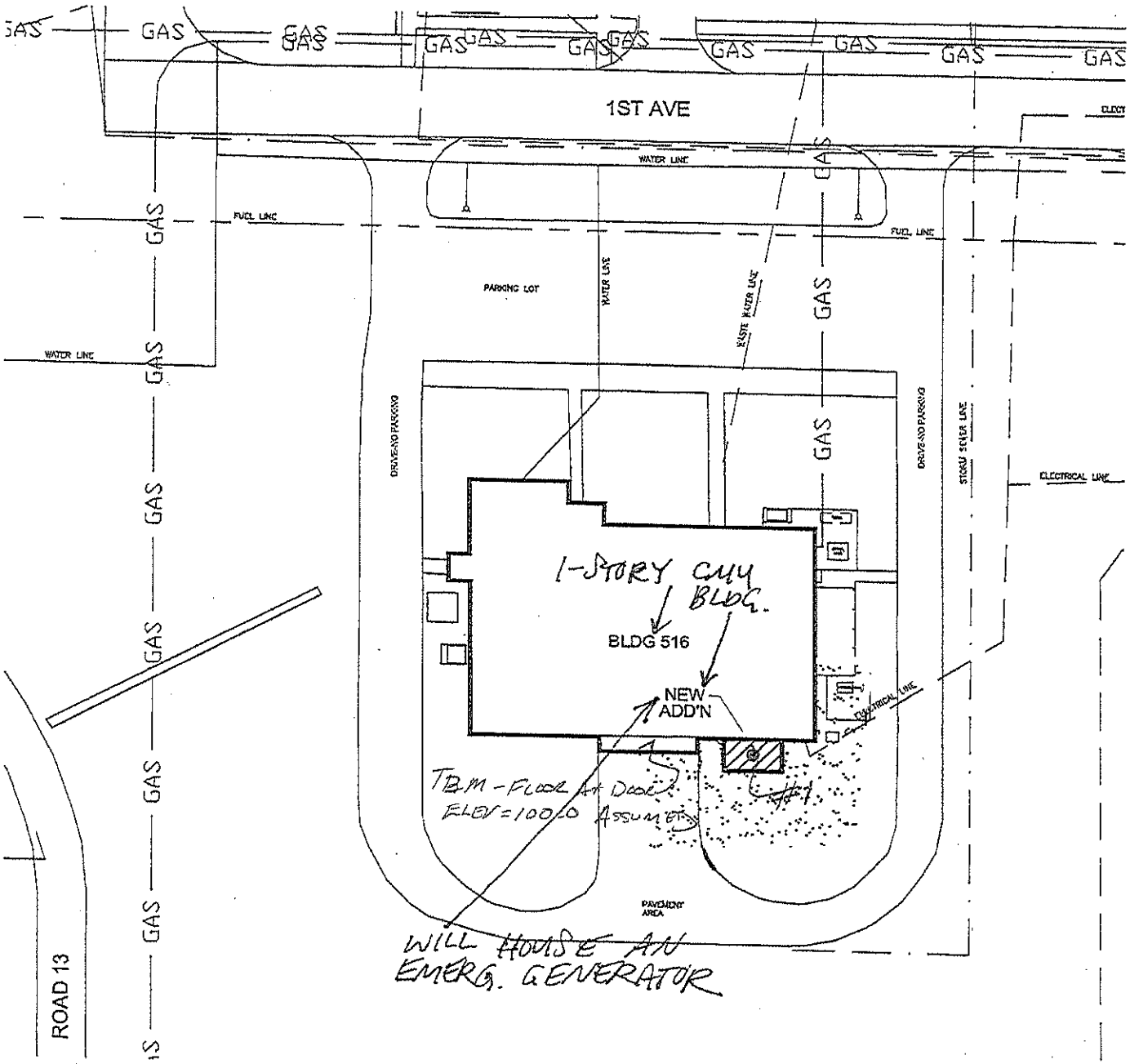
Symbols	Definition
LL	Liquid Limit, %
PL	Plastic Limit, %
Q_u	Unconfined Compressive Strength, psf
Additional insertions in Q_u column	
G	Specific Gravity
SL	Shrinkage Limit, %
pH	Hydrogen Ion Content-Meter Method
O	Organic Content, % - Combustion Method
M.A.	Grain Size Analysis - Mechanical Method
Hyd.	Grain Size Analysis - Hydrometer Method
C	One-Dimensional Consolidation
Q_c	Triaxial Compression
K	Coefficient of Permeability

WATER LEVEL INFORMATION

Water levels shown on the boring logs are levels measured in the borings at the time and under the conditions noted. In sand, the indicated levels can be considered reliable. In clay soil, it is not possible to determine the ground water level within the normal scope of a test boring investigation, except where lenses or layers of more pervious water-bearing soils are present. Even then, a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level noted on the boring logs for cohesive or mixed-texture soils may not indicate the true level of the ground water table.

SOIL STRATIFICATION BOUNDARIES

The soil stratification lines shown on the boring logs indicate the approximate boundary between different soil types. In the field, the transition between soil types may be gradual.



B516
SITE LAYOUT PLAN

NOT TO SCALE

North

MTL PROJECT NO. G4282

DIVISION 2 - SITEWORK

SECTION 02 20 00
SITE DEMOLITION

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Building Demolition	Section 02 41 00

REQUIREMENTS OF REGULATORY AGENCIES

All demolition work shall be accomplished in accordance with all applicable local, state and federal requirements.

All items scheduled to be removed by the Contractor shall become the property of the Contractor, and shall be removed from the site. Material shall not be stored on the site for sale, nor shall the Contractor conduct any sale on the site.

CHARGES BY UTILITY COMPANIES

Any charges or fees by the utility companies related to utility locating, demolition, relocation, capping, etc. shall be paid directly by the respective Mechanical or Electrical Subcontractors as outlined in Divisions 22, 23, 26 and 27. Any work related to capping, etc., not normally performed by the Utility Company shall be performed by the respective Mechanical or Electrical Subcontractors and the cost shall be included in their sub-bid.

REVIEW OF DEMOLITION SCOPE BEFORE BIDDING

The Contractor shall thoroughly review the Contract Documents before submittal of Bid in order to determine the scope of the demolition involved. All existing materials which are shown or noted to be demolished on the Drawings are for the general information of the Contractor only. The Government will not be responsible for any additional expense to the Contractor if the conditions causing those expenses could have been discovered in an on-site inspection prior to bid submittal.

OWNERSHIP OF REMOVED MATERIALS

Items to be removed by the Contractor and reinstalled by him shall be as follows:

- Items so noted on the Drawings.

Items to be removed and retained by the Government prior to the start of demolition work are as listed below or on the Drawings. Any items still remaining when Contractor enters each particular site area to start demolition work shall be removed and disposed of by the Contractor at no additional expense to the Government, including:

- Items so noted on the Drawings

All other items scheduled to be removed by the Contractor shall become the property of the Contractor, and shall be removed from the site. Material shall not be stored on the site for sale, nor shall the Contractor conduct any sale on the site.

The Government reserves the right to remove any other items from the building or site areas prior to the start of demolition by the Contractor and to retain such items as his property.

PROTECTION

Safety barricades and/or fences shall be provided as required during demolition operations and shall be left in place until sufficient replacement construction is completed.

B. PRODUCTS

MATERIALS

Barricade materials may consist of sound salvage materials, free of nails and sharp projections.

C. EXECUTION

REMOVAL OF EXISTING BURIED BUILDING MATERIALS AND EXISTING WALKS AND PAVING

Remove site materials regardless of how they are constructed. Components shall be removed as follows:

1. Under new paving or walk areas and non-paved areas, abandoned utilities shall be removed to a depth of at least 3 feet below finished grade..
2. Remove walks, drives, curbs, rubbish, junk, and miscellaneous items as shown on the Drawings.
3. In areas which will be under walks, paving, or building areas, any surface or buried materials which are observed to be of an unstable nature by the Contractor or the Soils Testing Laboratory representative shall be removed to the depths required to establish a stable sub-base as determined by the Testing Laboratory representative. Where such items could not be anticipated from the Drawings or Specifications, the cost of such unanticipated removal shall be included in a Change Order at amounts negotiated between the Contractor and the Contracting Officer.
4. Where paving, slabs or curbs are removed next to paving, slabs or curbs scheduled to remain, the paving, slabs or curbs shall be sawcut to provide a straight edge.

Dispose of rubbish, debris and material resulting from demolition and removal operations to an offsite area within a maximum of two weeks from the date of the removal from its original installation.

SECTION 02 41 00
BUILDING DEMOLITION

A. GENERAL

REQUIREMENTS OF REGULATORY AGENCIES

All demolition work shall be accomplished in accordance with all applicable local, state and federal requirements.

ASBESTOS-CONTAINING MATERIALS

There are known asbestos containing materials in the project work areas. See Section 02 82 14 for additional information. If, during removal work, the Contractor discovers any other material which he suspects may contain asbestos, he shall immediately notify the Contracting Officer and cease work in close proximity to the suspected asbestos-containing material. The Contracting Officer will then arrange for the testing and removal of any asbestos-containing materials. If time delays are encountered because of required asbestos removal work, the schedule shall be adjusted accordingly by Change Order.

OWNERSHIP OF REMOVED MATERIALS

Items to be removed by the Contractor and reinstalled by him include the following:

- Certain mechanical and electrical equipment items as shown on the Drawings.
- Other items so noted on the Drawings

Items to be removed and retained by the Government prior to the start of demolition work are as listed below or on the Drawings. Coordinate with the Government regarding scheduling removal work by the Government so such items are removed to the appropriate time so the building's functional and security needs are maintained.

Any items still remaining when Contractor enters each particular work area to start demolition work shall be removed and disposed of by the Contractor at no additional expense to the Government. Items to be removed and retained by the Government prior to the start of demolition work include the following:

- Items so noted on the Drawings

Items to be removed by the Contractor and turned over to the Government include the following:

- Items so noted on the Drawings

All other items scheduled to be removed by the Contractor shall become the property of the Contractor, and shall be removed from the site. Material shall not be stored on the site for sale, nor shall the Contractor conduct any sale on the site.

The Government reserves the right to remove any other items from the building or site areas prior to the start of demolition by the Contractor and to retain such items as his property.

UTILITY REMOVAL

This contract shall include removal of all utilities noted for removal. The Contractor shall arrange for the shut-off and disconnection of all abandoned utilities. Such utility disconnections shall be paid for by the Contractor. The Contractor shall take measures as required in properly protecting any utilities which are scheduled to remain throughout the period his demolition operations are in progress.

REVIEW OF DEMOLITION SCOPE BEFORE BIDDING

The Contractor shall be responsible for performing all work and providing all materials required to achieve the design intent shown on these Drawings. The Government will not be responsible for any additional expense to the Contractor if the conditions causing those expenses could have been discovered in an on-site inspection prior to bid submittal.

PROTECTION OF EXISTING BUILDINGS AND STRUCTURES

The Contractor shall guard against, and be responsible for, any movement, settlement, or collapse of adjacent buildings, structures, sidewalks, street passages, and underground utilities.

The Contractor shall repair damage done to the Government's property or any other property, on or off premises, by reason of required work.

Safety barricades and/or fences shall be provided as required during demolition operations and shall be left in place until sufficient replacement construction is completed.

Dustproof barriers shall be erected as required to prevent the spread of construction dust into adjacent areas outside the construction activity.

NOISE CONTROL

The Contractor shall use reasonable consideration in avoiding excessive or unnecessary noise during normal business hours.

B. PRODUCTS

MATERIALS

Barricade materials may consist of sound salvage materials, free of nails and sharp projections.

C. EXECUTION

REMOVALS

1. Remove existing mechanical and electrical items and structures noted for removal.

Dispose of rubbish, debris and material resulting from demolition and removal operations to an offsite area within a maximum of one week from the date of the removal from its original installation.

SECTION 02 82 14
ASBESTOS REMOVAL AND DISPOSAL

SCOPE OF WORK

The work covered by this Section includes furnishing all labor, equipment, materials, and transportation necessary for the proper and safe removal, handling, and disposal of asbestos containing/contaminated materials required in this project as shown on the Asbestos Abatement Plan later in this Section.

Work areas known to contain asbestos are identified later in this Section. For any other areas suspected to contain asbestos, which would be impacted by the work involved and are not previously identified in the scope, the Contractor shall notify the Contracting Officer who will secure bulk samples to be analyzed by an EPA-approved laboratory at no cost to the Contractor. Any additional areas identified as Asbestos Containing Materials (ACM) (friable and/or non-friable) shall be approved for removal by the Contracting Officer.

AVAILABLE ASBESTOS SURVEY REPORTS

An Asbestos Survey Report was performed on this facility in 2009. Portions of that report are attached at the end of this Section. If desired by the Contractor, complete copies of the report can be made available, when requested in writing to the Contract Officer.

APPLICABLE PUBLICATIONS

The publications listed below form a part of this Section to the extent that these publications are to be complied with. The publications are referred to in the text by basic designation only.

TITLE 29, CODE OF FEDERAL REGULATIONS, US DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY, AND HEALTH ADMINISTRATION (OSHA) STANDARDS. Part 1910.20 Access to Employee Exposure and Medical Records Part 1910.95 Occupational Noise Exposure Part 1910.13 Respiratory Protection Part 1926.1101 Asbestos.

TITLE 40, CODE OF FEDERAL REGULATIONS, U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) STANDARDS. Part 61, National Emission Standards for Hazardous Air Pollutants; Asbestos NESHAP Revision; Final Rule, and Part 763 Asbestos Containing Materials in Schools; Final Rule and Notice.

TITLE 49, CODE OF FEDERAL REGULATIONS, U.S. DEPARTMENT OF TRANSPORTATION (DOT) STANDARDS. Part 171 Hazardous Substances Part 172, Hazardous Materials; Final Rule and Part 173, Shippers - General Requirements for Subpart M Shipments and Packaging.

APPLICABLE STATE ORDINANCES AND CODES.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARDS. Z9.2-1979 Fundamentals Governing the Design and Operation of Local Exhaust Systems

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH) PUBLICATION. Manual of Analytical Methods, 3rd Ed., Vol. 1 and 2

UNDERWRITERS LABORATORIES INC. (UL) PUBLICATION. 586-77 (R-1982) Test Performance of High Efficiency Particulate Air Filter Units

http://www.ndhealth.gov/aq/iaq/asb/

North Dakota Air Pollution Control Rules:
- Administrative Code, 33-15-13, Emission Standards for Hazardous Air Pollutants
- Century Code, Chapter 23-Health and Safety, Chapter 25-Air Pollution Control

IDENTIFICATION OF ASBESTOS CONTAINING MATERIALS

The quantities of confirmed asbestos-containing building materials reported in this document are provided only as approximations. The following table represents those quantities of asbestos containing material:

Location	Material	Approximate Quantity
• Interior, various areas	Mechanical fitting pipe insulation	See Drawing later in this Section
• Interior, Room 106	Floor tile mastic	See Drawing later in this Section

REQUIRED NOTIFICATIONS

All applicable notifications should identify this project as a "Renovation" project. All notifications and permits are the sole responsibility of the Contractor. All notifications shall be submitted to all state, local and federal agencies. The Asbestos NESHAP, 33-15-13-02 Code of the North Dakota Air Pollution Control Rules, requires written notification of demolition or renovation activities under Subsection 02.6 regardless of the presence of asbestos containing material. The Contractor (through the Contracting Officer) shall coordinate the written “Notification of Demolition and Renovation” with Grand Forks AFB’s Environmental Flight a minimum of ten days prior to start of renovation activities.

REVIEW OF ABATEMENT SCOPE BEFORE BIDDING

The Contractor shall be responsible for performing all work and providing all materials required to achieve the work of this Section. The Government will not be responsible for any additional expense to the Contractor if the conditions causing those expenses could have been discovered in an on-site inspection prior to bid submittal.

SAFETY

Under government workplace safety regulations, the Contractor is responsible for the training of his employees. The Contractor is to ensure that its’ employees and the Competent Person have completed all necessary Safety Training.

CONSTRUCTION DRAWINGS

All drawings issued herein shall be used as reference and orientation only. The Contractor is required to check and verify all conditions at the site and shall assume full responsibility for the accuracy of the same.

UTILITIES

All electrical circuits and light in or affected by asbestos control area shall be de-energized. It is the Contractor's responsibility to provide labor or materials to maintain temporary power and lighting in the asbestos abatement areas and in areas of the building where operations may be affected by the removal. Temporary electrical service utilized in the enclosure shall be connected to ground fault-protected outlets located outside the enclosure.

Connection to any water, gas and/or electricity shall be coordinated with and approved by the Contracting Officer. The cost of hookup or disconnection of any item of equipment either for test purposes or for use in construction shall be borne by the Contractor. The cost of the water, gas and electricity shall be borne by the Government. Any cost incurred for the hookup and disconnection of any existing utilities shall be borne by the Contractor.

OCCUPANCY

The Contractor must provide for the continuing access to various parts of the building by authorized individuals. Signs, screens, temporary curtains, etc. shall be provided if necessary to maintain the routine business operations within and around the facility. The Contractor shall schedule his operations so that conflict and disturbance to facility operations are kept to a minimum.

HOUSEKEEPING

On completion of the work, the Contractor shall remove from the building site all construction materials and rubbish resulting from his work.

ASBESTOS DISPOSAL

Contractor shall dispose of all asbestos-containing and/or contaminated material in an EPA-approved landfill. The Government's asbestos-containing material shall not be mixed with asbestos-containing/contaminated waste generated by other entities. Manifests must reflect only material which was abated from this facility.

INSPECTION

The Contracting Officer is authorized to call the attention of the Contractor to any failure of the work or materials to conform to the provisions of the contract. The Contractor is responsible for all costs associated with reinspections of failed work. The Inspector shall have the authority to reject materials or suspend the work until any questions at issue can be referred to and decided by the Contracting Officer. Costs associated with suspension of work, including but not limited to costs incurred by the Contracting Officer, the Government's third party Contractor(s), (if utilized), and the Contractor shall be borne by the Contractor.

DAMAGES INCURRED

The Contractor shall take precautions and use extreme care to avoid damage to any of the buildings furnishings, adjacent facilities, the building itself and any connected utilities, and carry out any necessary temporary and/or permanent repairs for which he is legally liable.

The Contractor will be assessed the cost of any and all additional consulting, inspection, testing and analytical services incurred by the Government. These costs may include but are not limited to the following:

- Costs of all management, labor and costs, both direct and indirect, to satisfactorily complete the project in excess of the number of work shifts identified by the Contractor.
- Expenses incurred by the Government if the Contractor fails to begin the project beyond the scheduled start date and the Contracting Officer is on-site.
- Expenses incurred by the Government if the work is suspended due to the Contractor's actions and the Contracting Officer is on-site.

SUBMITTALS / CLOSE-OUT REQUIREMENTS

The Contractor shall submit data on the following items specified herein prior to start of work in accordance with Section 01000:

PRIOR TO START SUBMITTALS:

1. NOTIFICATIONS, CERTIFICATIONS, AND LICENSE: The Contractor shall be responsible for obtaining a license as a business entity and certifications of all personnel in accordance with the appropriate State regulations regarding asbestos removal, handling, and disposal. At least 10 days prior to the commencement of any asbestos removal/demolition, the Contractor shall prepare written notification in accordance with EPA, 40 CFR, 763, Part 61, Subpart M, to the applicable State and City, if necessary.
   - Copies of this notification shall be forwarded to the appropriate EPA Regional Office.
   - The Contractor shall submit copies of all of these notifications to the Contracting Officer not less than 5 working days prior to the start of asbestos abatement.
   - The Contractor shall submit copies of any local and/or state response letters they receive to the Contracting Officer no later than 10 days after receipt and prior to commencing any on-site work.

2. PROOF OF LICENSE AND CERTIFICATION. The Contractor shall submit proof to the Contracting Officer that they are licensed in the appropriate state prior to the start of asbestos abatement. The Contractor shall also submit proof that each employee who will be involved in this project is certified in that state in accordance with the above regulations; proof of their certificates shall be submitted prior to the start of the project.

3. PROOF OF EMPLOYEE TRAINING AND MEDICAL EXAMINATION. Prior to the start of asbestos

abatement, the Contractor shall submit proof to the Contracting Officer that:

- Employees and the Competent Person, as defined in 29 CFR 1926.1101, have been trained in accordance with the appropriate state regulations and as defined in all other applicable regulations.
- The Competent Person will be continuously on-site during all asbestos abatement procedures.
- The employees and the Competent Person have completed all medical examinations as required by the applicable regulations.

4. ASBESTOS REMOVAL AND DISPOSAL PLAN. Prior to the start of asbestos abatement, the Contractor shall submit a written Asbestos Removal and Disposal Plan as described in Part 13.16 of Section 01000 to be followed during the removal and disposal of asbestos-containing materials in this project indicating all areas requiring asbestos abatement, a description of abatement procedures (including whether full containment will or will not be utilized), and an approximate duration (in working hours/days) for the abatement to occur in each area. Also include in the Plan information regarding employee training; medical examinations and fitness reports; personal protective equipment such as the respirator and clothing; employee decontamination; emergency procedures; pre-removal preparation, asbestos abatement and post-removal clean-up verification procedures; air monitoring, sampling and final clearance sampling; sequencing of asbestos-related work and the interfacing with other trades involved in construction; and waste storage and disposal. The Plan shall be submitted to the Contracting Officer for approval which must be granted prior to the start of work on each contaminated or assumed-to-be contaminated work site. Descriptions, drawings, and site layouts of work site isolation enclosures and negative air pressure systems locations, decontamination and temporary waste storage facilities and the boundaries of contaminated work areas shall also be provided for approval prior to the start of work as part of the Plan.

5. MISCELLANEOUS. Prior to the start of asbestos abatement, the Contractor shall submit the following:

- Respiratory Protection Plan
- Project Contact List: to include phone numbers (cell and office) for all project supervisors and managers

END OF PROJECT CLOSE-OUT:

1. TEST RESULTS. All Test Results will be made available to the Contracting Officer:

- Air Sampling and Analysis. All costs associated with air monitoring and analysis and all OSHA personnel air monitoring requirements shall be borne by the Contractor.
- Air Monitoring Results. Shall be reported to the Contracting Officer within 24 hours after the completion of a sampling period with written results to be submitted to the Contracting Officer within 5 working days. Test results shall indicate each sample's pump serial number, time weighted average (TWA) fiber count, pump start time, pump stop time, date, pump flow rate, and exact location of where the sample was taken.

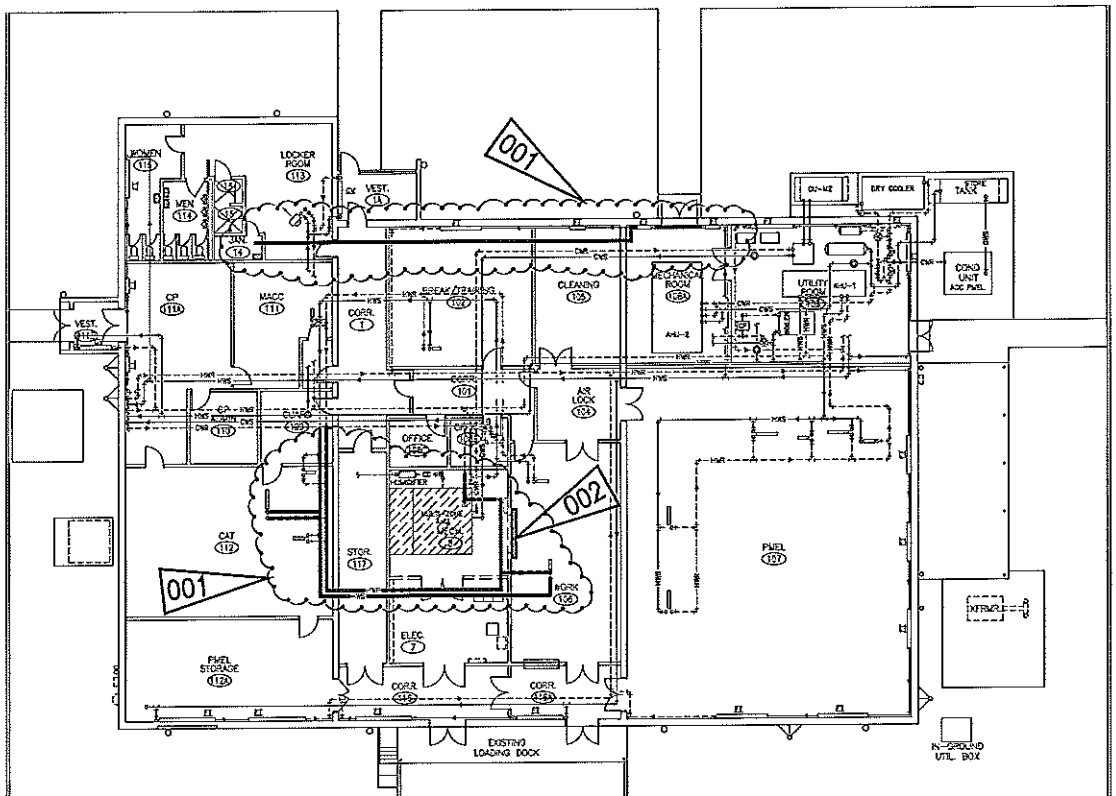
2. WASTE MANIFESTS. The Contractor shall obtain a list of approved sanitary landfills for asbestos disposal from the EPA and/or applicable State regulatory agencies. Prior to the start of asbestos abatement, the Contractor shall submit to the Contracting Officer a copy of the written notification that was sent to the disposal site operator/owner of the intent to dispose of the asbestos-containing materials including the estimated quantity and the tentative date for disposal. Upon completion of asbestos abatement, the Contractor shall submit proof to the Contracting Officer that all of the asbestos-containing materials have been disposed of in accordance with all applicable regulations. This shall include acknowledgment from the disposal site operator/owner in writing that the waste has been delivered in a manner and condition acceptable to the disposal site operator/owner.

3. SUPERVISOR'S LOGS. At the completion of all site work, the Contractor shall submit all pertinent documents pertaining to the project. Close-out should include, but not be limited to the following items: supervisor's logs, entry logs, notice of substantial completion and final project documentation, and Contractor project job diary.

ASBESTOS ABATEMENT PLAN FLAG NOTES

001 AT ALL PIPING SHOWN BOLD INSIDE THIS CLOUDED AREA IMPACTED BY THE WORK OF THIS PROJECT, REMOVE ASBESTOS – CONTAINING PIPE INSULATION FITTINGS AT ALL PIPE FITTINGS AS REQUIRED TO COMPLETE THE WORK OF THIS PROJECT. SEE MECHANICAL DRAWINGS FOR ADDITIONAL INFORMATION.

002 AT THIS VINYL FLOOR TILE AREA IMPACTED BY THE WORK OF THIS PROJECT SHOWN BOLD, REMOVE NON–ASBESTOS – CONTAINING VINYL FLOOR TILE AND ASBESTOS – CONTAINING FLOOR TILE MASTIC AS REQUIRED TO PERFORM THE WORK OF THIS PROJECT.



ASBESTOS ABATEMENT PLAN

NOT TO SCALE

N

L E G E N D
Technical Services, Inc.
www.legend-group.com

FINAL REPORT

Asbestos and Screening Lead Survey
Grand Forks AFB Bld # 516

LEGEND NO. 0900801

December 30, 2009

Submitted By:

LEGEND TECHNICAL SERVICES, INC.

Minnesota: 88 Empire Drive, St. Paul, MN 55103, 651/642-1150
North Dakota Operations: 1128 Westrac Drive South, Fargo, ND 58103, 701/271-6779
Wisconsin Operations: 1324 West Clairemont Avenue, Suite #12 Eau Claire, WI 54701 715/955-4839
Arizona Operations: 17631 N. 25th Avenue, Phoenix, AZ 85023, 602/942-8220

NARRATIVE REPORT

1.0 INTRODUCTION

This is the final report of LEGEND TECHNICAL SERVICES, INC. (LEGEND) limited asbestos and lead screening survey performed in the PMEL Building #516 located on the Grand Forks Air Force Base in Grand Forks, North Dakota.

Site work was performed on November 17, 2009. Mr. Andrew Schweyen (ND Asbestos Inspector #4533) and Mr. Christopher Flaten (ND Asbestos Inspector #4240) performed the asbestos survey for LEGEND. Lead sampling by XRF was conducted for LEGEND by Christopher Flaten (ND Lead Risk Assessor #149).

2.0 BACKGROUND INFORMATION

Building #516 serves as the PMEL for the Grand Forks Air Force Base. Reportedly, the building will be impacted by renovation to replace the air handler and HVAC system in the central mechanical area. Access to the building was provided by Greg Sturdevant from base Civil Engineering.

The building is built slab on grade. The exterior siding consists of concrete block. The floor finishing's in the areas to be impacted consisted of 12" floor tile over concrete and concrete. The walls in the impact area were finished with gypsum wallboard (GWB) and concrete block. Ceilings were constructed of lay in ceiling tiles, metal decking, and GWB.

LEGEND did not open up any wall cavities to look for concealed asbestos, as destructive sampling techniques were not permitted.

3.0 METHODOLOGIES

3.1 Asbestos Sampling/Analysis Survey

An asbestos bulk survey was conducted of the areas to be impacted by renovation. The asbestos survey included collecting at least one sample of each suspect asbestos containing material. Sample analysis was performed in LEGEND's NVLAP accredited laboratory.

Analysis for the presence of asbestos fibers in bulk samples is performed using polarized light microscopy (PLM) and dispersion staining techniques. The analysis was performed using an Olympus BHSP microscope at 40-200X magnification in accordance with EPA Method for the Determination of Asbestos in Bulk Building Materials, United States EPA 600/R-93/116, 1993.

LEGEND's lower detectable limit for bulk asbestos fiber concentration is 1% based on EPA/NVLAP (National Voluntary Laboratory Accreditation Program) sample analysis procedures using PLM. Samples reported, as "None Detected" contained no detectable fibers in the sample portions analyzed.

4.0 FINDINGS

4.1 Suspect Asbestos Materials Identified and Sampled

Gypsum Wallboard (GWB)	Joint Compound
GWB and Joint Compound Composite	Wall Texture
Ceiling Tile (3 types)	Floor Tile (3 types)
Mastic (2 types)	Mag-Block Pipe Insulation
Hard Fitting on Mag-Block Pipe Insulation	Wall Insulation Paper
Endcap on Fiberglass Insulation	Felt Paper
Endcap on Fiberglass Breeching	Flue Mud
Red Fire Stop	HVAC Dampener

4.2 Asbestos Containing Materials (ACM)

Thirty-one (31) samples were collected from the areas to be impacted by renovation. **Six (6) of the thirty-one (31) samples collected tested positive for asbestos.**

Table A
Asbestos Containing Building Materials (ACM)

ASBESTOS CONTAINING MATERIAL	LOCATIONS		CATORGORY
Black Mastic (Floor Tile is Negative)	Rooms 106 and 116		CAT I
Mag-Block Pipe Insulation	Rooms 106, 116, and 116A		RACM
Hard Fittings on Mag-Block Pipe Insulation	Rooms 116 and 116A		RACM

RACM (Regulated Asbestos Containing Material) – Friable asbestos containing material (ACM) includes surfacing (sprayed, troweled-on or otherwise applied to surfaces) and Thermal System Insulation (ACM applied to pipes, fittings, boilers, breeching, tanks ducts, or other structural components to prevent heat loss or gain).

CAT I (Category I) – Non-friable asbestos containing material includes floor tile, floor tile mastic, roofing, packing, and gaskets.
CAT II (Category II) – Non-friable asbestos containing material includes all other non-friable materials.

Refer to Table #1 in Appendix A for complete sample results and Diagram #1 in Appendix B for bulk sample locations.

5.0 RECOMMENDATIONS

LEGEND recommends prior to any renovation or demolition, CAT I asbestos containing materials **ACM** (black floor tile mastic) should be abated by a state certified asbestos abatement contractor if the planned renovation or demolition activities will disturb these materials. Alternatively, **CAT I ACM** may remain in place if new components are placed over the existing asbestos-containing floor materials without disturbing the asbestos flooring. In addition, if the asbestos **CAT I ACM** is not to be impacted or disturbed in any manner they may remain in place.

Prior to any renovation or demolition, if the regulated asbestos containing materials **(RACM)** asbestos containing mag-block pipe insulation, or hard fittings on mag-block pipe insulation are to be impacted or disturbed in any manner, LEGEND recommends abatement by a state certified asbestos abatement contractor. If the asbestos pipe insulation and associated hard fittings are in good condition **(RACM)** and are not to be impacted or disturbed in any manner, they may remain in place.
Painted surfaces that were measured to be below the EPA's definition of lead based paint might create lead dust or lead-contaminated soil hazards if the paint is disturbed and turned into dust by abrasion, scraping, or sanding.

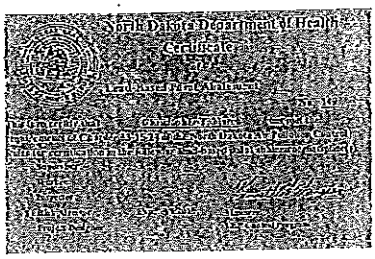
6.0 REMARKS

The recommendations in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted architectural, engineering, minimum code, and industrial hygiene practices at this time and location. Other than this, no warranty is implied or intended. The asbestos samples will be retained in our laboratory for a period of 30 days from the date of this report unless prior instructions are received from the client.

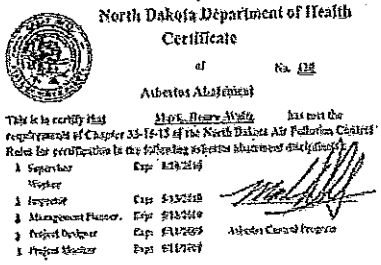
Cordially,

LEGEND TECHNICAL SERVICES, INC.

Christopher Flaten
Industrial Hygienist
ND Asbestos Inspector # 4240

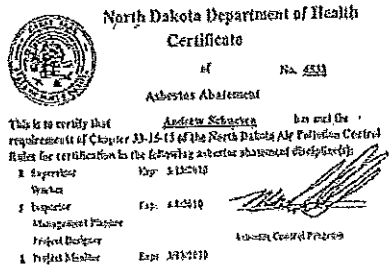

North Dakota Department of Health
Certificate
Asbestos Abatement

Mark Waltz
Fargo Manager
ND Asbestos Inspector # 120


North Dakota Department of Health
Certificate
of
No. 120
Asbestos Abatement
This is to certify that Mark Henry Waltz has met the requirements of Chapter 33-15-13 of the North Dakota Air Pollution Control Rules for certification in the following asbestos abatement discipline(s):
1 Supervisor Exp: 8/31/2010
Worker
1 Inspector Exp: 8/31/2010
1 Management Planner Exp: 8/31/2010
1 Project Designer Exp: 8/31/2010
1 Project Monitor Exp: 8/31/2010
Asbestos Control Program

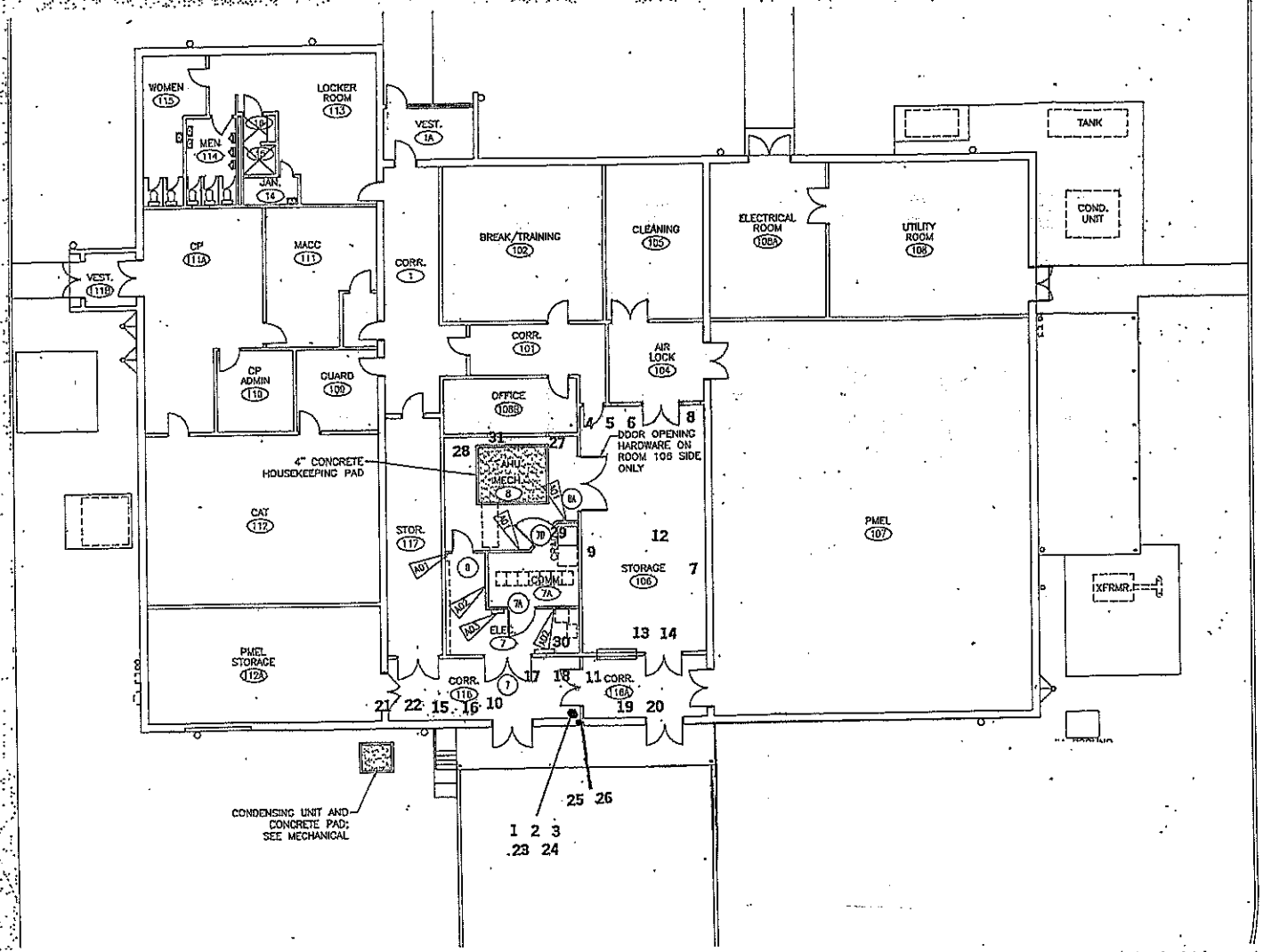
for Todd Gorgi
Microscopist

Andrew Schweyen
Industrial Hygienist
ND Asbestos Inspector #4533


North Dakota Department of Health
Certificate
of
No. 4533
Asbestos Abatement
This is to certify that Andrew Schweyen has met the requirements of Chapter 33-15-13 of the North Dakota Air Pollution Control Rules for certification in the following asbestos abatement discipline(s):
1 Supervisor Exp: 8/31/2010
Worker
1 Inspector Exp: 8/31/2010
Management Planner
Project Designer
1 Project Monitor Exp: 8/31/2010
Asbestos Control Program

Asbestos Bulk Sample Locations

LEGEND Technical Services, Inc.



DIVISION 3 - CONCRETE

SECTION 03 10 00
CONCRETE FORMWORK

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Concrete Reinforcing	Section 03 20 00
Cast-In-Place Concrete	Section 03 30 00

QUALITY ASSURANCE

Design of formwork, shoring and bracing shall be the responsibility of the Contractor. All formwork shall comply with the requirements of ACI 301 and ACI 304, except as modified by this Specification.

B. PRODUCTS

MATERIALS

Forms and shoring materials to be used are to be determined by the Contractor but the final concrete finish on exposed concrete, after removal of the forms, shall be smooth, uniform and in alignment.

Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two edges and one face for tight fit.

Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

Chamfer strips shall be a non-absorbent material designed to be compatible with the selected surface, and shall be one of the following:

- Polyvinyl Chloride
- Fiberglass
- Steel
- Smooth Milled Hardwood, fully sealed on all sides with an approved wood sealer

Through bolts and anchorages shall be sized as required of strength and character to maintain formwork in place while placing concrete.

Form ties shall be removable, snap-off metal of adjustable length, shall include weatherproofing washers, and shall leave holes no larger than one-inch diameter in concrete surface.

Rigid insulation beneath slabs (where shown on Drawings) shall be rigid extruded polystyrene board, complying with ASTM C 578, Type IV. Thickness shall be as shown on Drawings.

C. EXECUTION

INSPECTION

Contractor shall verify lines, levels, and measurements before proceeding with form work.

FORM BLOCKOUTS

Provide form blockouts as shown on the Drawings.

FORM ERECTION

Erect forms to conform to shapes, lines, and dimensions of the members as shown on the Drawings. Forms shall

be sufficiently tight to prevent leakage of mortar, and shall be properly braced or tied together so as to maintain position and shape.

Earth cuts may be used as a form for footings and grade beams below grade, provided the bearing surfaces of the earth-formed trenches are kept free of loose materials and debris and the trench sidewalls remain stable and vertical.

Provide formed openings where required for work embedded in or passing through concrete.

Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

Coat contact surfaces of forms with a form coating compound before reinforcement is placed. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

Thoroughly clean forms and adjacent surfaces to receive concrete. Retighten forms and bracing after placement of concrete as required to eliminate mortar leaks and maintain proper alignment.

Moisten wood forms immediately before placing concrete where form coatings are not used.

INSTALLATION OF RIGID INSULATION

Level subgrade and set insulation on top. Cut and fit insulation together and around obstructions. Protect insulation from displacement and damage prior to pouring concrete slab above.

FORM REMOVAL

Remove forms in such a manner as to ensure the complete safety of the structure. Where the structure is supported on shores, the removable forms may be removed after 24 hours providing the concrete will not be injured. In no case shall supporting forms or shoring be removed until members have acquired sufficient strength to support their weight and imposed loads safely.

SECTION 03 20 00
CONCRETE REINFORCEMENT

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Testing Laboratory Services	Section 01 40 00
Concrete Formwork	Section 03 10 00
Cast-In-Place Concrete	Section 03 30 00

QUALITY ASSURANCE

Fabrication and installation shall meet the requirements of CRSI Manual of Standard Practice and CRSI Documents 63 and 65, and ACI 315 and ACI 301, except as modified by this Specification.

Upon request, the Contractor shall furnish certified copies of mill test reports covering chemical and physical properties of reinforcing steel.

SUBMITTALS

Shop Drawings shall be prepared by the Contractor in accordance with ACI 315 and submitted in accordance with Section 01000. Indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting and spacing devices.

CERTIFICATES

Upon request, submit mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

STORAGE AND HANDLING

Store, handle and clean reinforcing as necessary to keep it free of dirt, loose mill scale and rust, paint, oil, or other foreign material that will destroy or reduce bond.

B. PRODUCTS

MATERIALS

Reinforcing bars shall meet the requirements of Standard Specification for Deformed Billet-Steel Bars for Concrete Reinforcement, ASTM A 615. Reinforcing shall be Grade 60.

Reinforcing bars which are to be welded (noted on the Drawings as deformed anchor bars) shall exceed the requirements of ASTM A 706 to assure weldability in conformance with Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Construction, AWS D12.1.

Stirrup steel shall conform to ANSI/ASTM A 82.

Chairs, bolsters, bar supports, and spacers shall be sized and shaped for strength and support of reinforcement during installation and placement of concrete. Use noncorrosive supports to prevent surface staining where supports are in contact with an exposed concrete surface.

Tie wire shall be minimum 16-gauge annealed type.

C. EXECUTION

FABRICATION

Fabricate in accordance with ACI 315, providing concrete cover specified in Section 03300, Cast-In-Place Concrete.

Locate reinforcing splices not indicated on Drawings at points of minimum stress.

Weld reinforcing bars in accordance with ANSI/AWS D1.4.

PLACING REINFORCEMENT

Before placing concrete, clean reinforcement of foreign particles or coatings.

Place reinforcement bars accurately and secure them adequately to resist displacement.

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Testing Laboratory Services	Section 01 40 00
Formwork	Section 03 10 00
Reinforcing	Section 03 20 00
Joint Sealers	Section 07 92 00

CONCRETE QUALITY AND WORKMANSHIP

ACI 318, American Concrete Institute Building Code Requirements for Reinforced Concrete, shall be the minimum design and construction standards. Concrete work shall conform to all requirements of ACI 301, "Specifications for Structural Concrete for Buildings", except as hereinafter modified or supplemented. The Contractor shall keep at least one copy of ACI 301 in the field office at all times.

TESTING SERVICE

A qualified Testing Laboratory Service shall perform installation evaluation tests/inspections on the work of this Section. See testing requirements described at the end of this Section, and see Section 01 40 00 for additional information.

SUBMITTALS

Submit the following as Shop Drawings for each mix to be provided in accordance with Section 01000:

- Source of each aggregate
- Aggregate gradation
- Pounds of aggregate per cubic yard
- Pounds of water per pound of cement
- Slump in inches
- Percent air content
- Type and quantity of admixtures used
- Compressive strength
- Mix designs (ACI 318)

Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

Make no alterations in materials without approval. Water **shall not** be added at the jobsite to change the approved mix design. Concrete shall be rejected where water has been added. No exceptions will be made.

ENVIRONMENTAL REQUIREMENTS

Cold weather requirements shall conform to ACI 306, Recommended Practice for Cold Weather Concreting.

Hot weather requirements shall conform to ACI 305, Recommended Practice for Hot Weather Concreting.

B. PRODUCTS

MATERIALS

Portland cement shall conform to ASTM C 150, Type I. Color shall be standard gray color at all areas.

Normal weight aggregates shall conform to ASTM C 33, except that the gradation shall be altered to use sand-gravel as the fine aggregate and limestone as the coarse aggregate for all concrete other than that used for footings. All concrete shall contain 30% limestone by weight of the total aggregate, except at topping mixes or as otherwise noted.

Water shall be potable, clean and not detrimental to concrete.

ADMIXTURES

1. Air-entraining admixtures shall conform to ASTM C 260.
2. Use water-reducing admixture in all concrete.
3. Other admixtures, if used, shall conform to ASTM C 494.

Do not use calcium chloride, salt and other materials containing anti-freeze agents or chemical accelerators.

Use one of the following curing compounds (protective coatings):
- Kure-N-Seal by Sonneborn Division of Contech, Inc.
- Surfaseal by L&M Construction Chemicals, Inc.
- Acryseal by Protex Industries, Inc.
- CS-309 by W.R. Meadows, Inc.
- Acrylic Curing Compound by Nebraska Builders Products

PROPORTIONING AND DESIGN OF MIXES

Provide 4,000 PSI, 28-day compressive strength concrete, with 611 lbs. cement per cu. yd. minimum, a W/C ratio of 0.42 maximum, and air entrainment of 6% +/- 1%.

Design adjustment may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the Government and as accepted by the Contracting Officer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Contracting Officer before using in work.

Proportion and design mixes to result in concrete slump at point of placement of not less than 1" and not more than 4".

CONCRETE PRODUCTION

Produce and deliver ready-mixed concrete in accordance with ASTM C 94. Excessive slump or more than one hour between mixing and placing will be considered as a basis for rejection of the load.

Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cubic yard or smaller capacity, continue mixing at least 1 1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cubic yard, increase minimum 1 1/2 minutes of mixing time by 15 seconds for each additional cubic yard, or fraction thereof.

For ready-mix concrete, comply with requirements of ASTM C 94, and as herein specified. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to the batch will not be permitted.

When air temperature is between 85 deg. F and 90 deg. F, reduce mixing and delivery time from 90 minutes to 75 minutes, and when air temperature is above 90 deg. F, reduce mixing and delivery time to 60 minutes.

C. EXECUTION

PREPARATION

Clean equipment for mixing and transporting concrete. Forms shall be thoroughly wetted (except in freezing weather) or oiled. Clean reinforcement of ice, dirt, rust, scale, or other coatings. Remove debris, water, and ice from the place of deposit of concrete. Remove laitance and other unsound material from hardened concrete before additional concrete is added.

Schedule delivery of concrete to assure prompt discharge upon truck arrival to site.

INSTALLATION OF EMBEDDED ITEMS

Set and build into work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations of slab surfaces.

PREPARATION

Prepare previously-placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.

CONVEYING AND PLACING

Convey concrete from trucks to the place of final deposit by methods that will prevent separation or loss of materials.

Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete at the delivery end without separation of materials.

Place concrete in accordance with ACI 301. Pump concrete in accordance with ACI 304.

Maintain concrete cover around reinforcing as follows (unless indicated otherwise on the Drawings):

Item	Coverage
Footings and Concrete (formed against earth)	3"
Slabs on Fill	2"

Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Place concrete at a rate so that concrete is plastic and flows readily into the spaces between the bars. Concrete that has been contaminated by foreign material shall not be used. When placing is once started, it shall be carried on as a continuous operation until placement of the panel or section is completed. Bring surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

CONSOLIDATION

Consolidate concrete in accordance with ACI 309.

VIBRATION

Vibrate with internal vibrators which maintain a speed of not less than 5,000 impulses per minute when submerged in the concrete. Limit the duration of vibration to that necessary to produce satisfactory consolidation without causing objectionable segregation, and vibrate 5 to 15 seconds at points 18 to 30" apart. Do not insert vibrator into lower courses that have begun to set.

FINISHING

Broom finish shall be used.

CURING AND PROTECTION

Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

Cure formed surfaces by moist curing while forms are in place.

TEMPORARY HEAT

The Contractor shall furnish such heating equipment as stoves or steam equipment and necessary fuel. When dry heat is used, means of maintaining atmospheric moisture shall be provided. The use of salamanders or other type of open flame heating unit is prohibited. A shield shall be provided on heating equipment involving combustion so that no metal exposed to the surface will be in contact with the source of heat.

The Contractor shall assume all risk connected with the placing of concrete during freezing weather, and permission given by the Government to place concrete during such time will in no way relieve the Contractor of his responsibility for satisfactory results. Any concrete showing injury by freezing shall be considered unacceptable. The Contractor is responsible for the quality and strength of concrete placed under any weather conditions.

Apply a membrane-forming curing compound immediately after finishing of flatwork is completed, in accordance with the manufacturer's written recommendations. At the completion of the project, after all clean-up has been completed, apply a second coat of curing compound (protective coating) to all concrete floors which will remain exposed.

MISCELLANEOUS CONCRETE ITEMS

Fill in holes and openings left in concrete structures for passage of work by other trades, unless noted otherwise, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

FIELD QUALITY CONTROL

The Contractor shall require that a test set be made for each 75 cubic yards of structural concrete or 5,000 square feet of surface area, but there shall be at least one test set for each day's concreting. Each test set shall include the following:

1. (Three) 6" x 12" or (four) 4" x 8" cylinders for Compression Tests to be made, tested, and evaluated in accordance with ACI 301.
2. One additional test cylinder shall be taken during cold weather and cured on site under same conditions as concrete it represents.
3. Slump Test made in accordance with ASTM C 143.
4. Test for Entrained Air Content in accordance with ASTM C 231 or ASTM C 173.

Test hourly when air temperature is 40 deg. F and below, and when 80 deg. F and above, and test each time a set of compression test specimens is made.

ADDITIONAL TESTS

The testing service will make additional test of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Contracting Officer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

DIVISION 4 - MASONRY

SECTION 04 20 00
UNIT MASONRY

A. GENERAL

PRODUCT DELIVERY AND HANDLING

Masonry units shall be delivered, unloaded and handled in a manner to adequately protect exposed corners, edges and faces from chipping, cracking or other damage. Such chipped or otherwise damaged units shall not be utilized in exposed wall areas but may be selected for utilization in concealed wall areas, if damaged characteristics are minor and do not effect the structural integrity of the wall.

Delivery of mortar materials other than aggregate and water shall be in sealed and labeled packages.

PRODUCT STORAGE

Masonry units shall be stored off the ground on pallets or in some manner that will prevent absorption of moisture from the ground or soiling of masonry units. Concrete masonry units shall be protected from becoming wet from rain, snow or capillary action.

Storage of mortar materials shall be in a manner to prevent deterioration or intrusion of foreign material. Material that has become unsuitable for good construction shall not be used and shall be immediately removed from the site.

JOB CONDITIONS

During cold and hot weather, masonry materials shall be stored, erected, and protected to meet the requirements of Technical Note No. 1 for "All Weather Construction", published by the Brick Institute of America, latest edition, or TEK Bulletin #3-1c “All-Weather Concrete Masonry Construction”, published by the National Concrete Masonry Association, latest edition.

Do not lay masonry units which are wet or frozen. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch. Remove all masonry determined to be damaged by freezing conditions.

B. PRODUCTS

CONCRETE MASONRY UNITS (CMU)

Concrete masonry units (CMU) shall be manufactured and tested by members of the National Concrete Masonry Association and shall meet the requirements of ASTM C 90.

All units shall be manufactured with standard weight aggregate (125 pounds per cubic feet or more, oven dry weight of concrete). Special shapes, including end and jamb blocks, solid top blocks, 45 degree corner blocks, sill blocks and lintel and bond beam blocks, etc. shall be furnished as shown or required.

Size of CMU shall be the manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15 5/8" x 7 5/8" actual), unless otherwise indicated. Thicknesses shall be as indicated on the Drawings.

Concrete brick shall meet the requirements of ASTM C55.

MORTAR MATERIALS

Portland Cement - ASTM C 150, Type I, except Type III may be used for cold weather construction.

- Provide natural gray color cement to produce mortar which matches the existing walls.

Masonry Cement - ASTM C 91.

Lime - Quicklime, ASTM C 5 or hydrated lime, Type S, ASTM C 207.

Aggregate for Mortar - ASTM C 144, except for joints less than 1/4", use aggregate graded with 100% passing the No. 16 sieve. Aggregate color, size, shape and texture shall match the original as closely as possible.

Aggregate for Grout - ASTM C 404.

Water - Clean and free of deleterious amounts of acid, alkalies, or organic materials.

Air-Entraining Admixtures - ASTM 260 added in accordance with the manufacturer's instructions.

Anti-Freeze Compounds - Not permitted. Do not lower the freezing point of mortar by use of admixtures or anti-freeze agents.

Accelerators shall not be used.

Bonding agents shall not be used.

MORTAR TYPES

Use Type S mortar for exterior CMU.

MORTAR MIXES

Mortar for all unit masonry shall conform to ASTM C 270. If masonry cement is used, it shall be measured, batched, and mixed according to the manufacturer's written instructions. The exact mix of the components of the mortar shall be adjusted as required to match the existing mortar as closely as possible as judged by the Government Construction Representative, while meeting the strength and water absorption requirements.

Grout shall conform to ASTM C476 and shall have a minimum 28-day compressive strength of 3,000 psi. Grout shall have a minimum cement content of 658 pounds per cubic yard. Where required, grout should be plastic, suitable for pumping without separation of constituents.

Unless hereinbefore allowed or disallowed by mortar manufacturer, mortar may be retempered by adding water within a basin formed with mortar and reworking the mortar within the water. Mortar which is unused two hours after initial mixing when air temperature is 80 deg. F or higher, and mortar which is unused three hours after initial mixing when air temperature is below 80 deg. F, shall be discarded.

C. EXECUTION

INSTALLATION

Cutting of masonry units shall be avoided, if possible. If cutting of exposed masonry units is necessary, it shall be done with a carborundum wheel, with all junctions and joints carefully and accurately fitted. No piece shorter than 4" shall be used at any vertical corner or jamb unless shown otherwise on the Drawings.

Do not wet concrete masonry units.

Where fresh masonry joins masonry that is partially or totally set on concrete, the surface to be joined shall be free of loose material and lightly wetted. When necessary to "stop off" a horizontal masonry run, it shall be done by racking back 2 lengths at each course and, if grout is used, stopping grout 4" back of rack. Toothing will not be permitted.

Masonry shall be laid up true and plumb, with special units (corners, jamb blocks, headers, fillers, closers, fitters, etc.) as required to form corners, returns, openings, and offsets, and maintain a proper bond throughout the length of wall.

All unit masonry shall be laid up in running bond, except where stack bond and header, rowlock or soldier courses are shown. Masonry bond and interlock each course of each wythe at corners and intersections, unless otherwise

shown.

Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets.

Rack back 1/2-masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if specified to be wetted), and remove loose masonry units and mortar prior to laying fresh masonry.

As the work progresses, build-in items specified under this and other sections of these specifications, including all door and window frames, steel lintels, bearing plates, anchors, sleeves and other miscellaneous items. Fill in solidly with masonry around built-in items.

Where built-in items are to be embedded in cells of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into cell.

Where new masonry abuts existing masonry, see Drawings for specific instructions regarding methods of abutment. Unless noted otherwise, non-toothed tie with a stacked mortar joint or caulked control/expansion joint will be required.

MORTAR BEDDING

1. Thickness: Unless otherwise indicated, horizontal and vertical mortar joints shall be 3/8" thick.
2. Hollow Units: Mortar bedding shall be placed under the face shells of units, but shall not extend across webs. Mortar shall be applied over the full thickness and height of face shells, or solid end faces and units shoved tight to form vertical joints.
3. Solid units shall be laid in full bed joints of mortar, and vertical surfaces shall be heavily buttered so mortar will be applied over full end area of units.
4. Avoid overplumbing and pounding corners and jambs to fit stretcher units after they are set in position.
5. Do not slush head joints.

Prevent grout, mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

See paragraph under "Mortar Mixes" earlier in this Section for information regarding retempering mortar.

If it is necessary to move a unit after it has once been set in place, the unit shall be removed from the wall, cleaned, and set in fresh mortar.

TOOLING AND POINTING

Joints shall be struck flush, and after mortar has partially set but is still sufficiently plastic to bond, joints shall be tooled with a tool which compacts mortar and presses excess mortar out of the joint rather than dragging it out. All joints shall be made with a straight, clean line.

Exercise special care to avoid getting mortar on faces of masonry which will be exposed without paint or other finish.

Joints shall be tooled concave unless otherwise noted.

Joints shall be struck flush at the following locations:
1. Walls concealed by other finish material.
2. All joints in chases, cavities and walls concealed above ceilings.

Joints which are not tight at the time of tooling shall be raked out, pointed, and then tooled.

MISCELLANEOUS MASONRY INSTALLATION REQUIREMENTS

Construct bond beams at locations shown on the Drawings. Unless otherwise indicated, bond beams shall be

reinforced with two No. 4 bars. Bond beams shall be bedded, reinforced and grouted the same as masonry lintels.

Unless otherwise shown on the Drawings, fill cores of concrete masonry units solid with grout at pilasters or piers, at two courses below bearing plates, at lintel bearing and where required to secure anchors and bolts, at all jambs at metal frames, and elsewhere as shown on the Drawings. Install metal lath in horizontal joint below cores to be filled solid with grout.

Fill space between hollow metal frames and masonry solidly with mortar of Portland cement/sand grout mixed to be as stiff as possible without interfering with proper workability and solid filling of jambs. Additives or mixtures which could cause internal rusting in frames are strictly prohibited.

Openings and chases for electrical ducts, pipes and conduits shall be built into masonry walls. Cutting of units to accommodate work of others shall be performed by masonry mechanics. Openings and chases shall be kept free from mortar and debris.

Lintels and bearing plates shall be set on full beds of mortar, as shown on the Drawings, leveled and at correct elevation.

REPAIR, POINTING AND CLEANING OF NEW WORK

Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

During the tooling of joints, enlarge any voids or holes, and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.

After completion of masonry work, or after all liability from stain or other operations on the building is passed, masonry shall be carefully cleaned, removing dirt, mortar, mortar ridges, stains, and other defacements. The use of wire brushes, strong acids, or solutions which might cause discoloration to work, disintegration of mortar, or adjacent materials will not be permitted. Cleaning down shall start at the top and be continued down until such work is finished.

Clean exposed CMU by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings. Comply with recommendations in NCMA TEK Bulletin No. 28.

REPAIR, POINTING AND CLEANING EXISTING MASONRY WORK TO REMAIN

Remove and replace exterior CMU where CMU was damaged during demolition work performed as a part of this Contract. Use matching CMU units and mortar for replacement.

DIVISION 5 - STEEL

SECTION 05 50 00
METAL FABRICATIONS

A. GENERAL

QUALITY ASSURANCE

Take field measurements prior to preparation of Shop Drawings and fabrication, where possible.

Fabricate, fit and assemble miscellaneous metal items in the shop. Work that cannot be permanently shop-assembled shall be completely assembled, marked, and disassembled before shipment to ensure proper assembly in the field.

B. PRODUCTS

MATERIALS

For metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes.

METALS

Unless otherwise shown or specified, metals for fabrication or miscellaneous metal items and fastenings shall be as follows:

Steel Plates, Shapes and Bars	ASTM A 36

FABRICATION

Form exposed work true to line and level. Ease exposed edges to a 1/32-inch radius. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work with exposed faces flat, smooth and free of deformation or distortion. Use concealed fasteners wherever possible. Use exposed fasteners of type shown, or if not shown, use Phillips flat head, countersunk screws or bolts.

Form exposed connections with hairline joints, flush and smooth. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush.

Cut, reinforce, drill and tap miscellaneous metal work as required to receive hardware and similar items.

SHOP PAINTING

Remove deleterious materials. Clean in accordance with SSPC SP1 "Solvent Cleaning", SSPC SP3 "Power Tool Cleaning", or SSPC SP6 "Commercial Blast Cleaning".

Shop paint all steel and iron fabrications, except portions of members to be embedded in concrete or masonry.

Immediately after preparation, prime metal fabrication with metal primer, in accordance with the manufacturer's printed instructions in full coverage of all faces, joints, corners, edges and other exposed surfaces with finished surfaces smooth and free of all runs, sags or misses.

ITEMS TO BE FABRICATED

Provide steel lintels of size and quantity for all openings as indicated or required, including openings for ductwork in masonry walls. Lintels shall have minimum 8” bearing unless otherwise noted.

Steel angles shall be provided for metal duct support at all roof openings greater than 12" x 12" in size. Angles shall extend to adjacent beams or joists and shall be installed on all four (4) sides except where openings are immediately adjacent to joists. Angles shall be 4" x 4" x 1/4" unless noted otherwise on the Drawings.

Fabricate miscellaneous and incidental items as shown on the Drawings or as required to complete the work.

Miscellaneous items include, but are not limited to the following:

1. Lintels at new interior masonry wall openings.
2. All other miscellaneous metal items as indicated on the Drawings.

C. EXECUTION

INSTALLATION

Set work accurately in location, alignment and elevation, plumb, level, true and free of rack. Provide temporary bracing for items to be built into concrete or masonry.

All steel items placed below grade or into concrete shall be coated or covered with asphaltic paint coating upon completion of placement or attachment to building construction.

COATING TOUCH-UP

Immediately after erection, clean abraded shop-painted areas, and paint exposed areas with same prime paint as used for shop painting. Provide a minimum 2.0 mils thickness.

DIVISION 6 - WOOD AND PLASTICS

SECTION 06 10 00
ROUGH CARPENTRY

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Wood Treatment	Section 06 30 00

QUALITY ASSURANCE

Comply with PS 20 and with applicable rules of the respective grading and inspecting agencies for species and products indicated.

Comply with PS 1-74 (ANSI 199.1) or, for products not manufactured under PS 1-74 provisions, with applicable APA Performance Standard for type of panel indicated. Identify each plywood panel with the appropriate APA Trademark.

All stress grades and stress criteria shall be based on the National Design Specifications for Wood Construction, latest edition.

STORAGE

Store lumber and rough carpentry materials on bunks or skids at least 6 inches above the ground, and protect materials from weather with waterproof covers.

JOB CONDITIONS

Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow proper attachment to other work.

B. PRODUCTS

MATERIALS

Lumber shall be S4S, kiln dried, with 19 percent maximum moisture content at time of dressing. Lumber shall be grade stamped in accordance with the latest edition of the standard grading rules of NELMA, SPIB, WCLIB, WWPA or NLGA (or equivalent Canadian governing authority).

CONCEALED BLOCKING

Wood blocking shall be nominal 2" thick and secured to structural members for the anchorage of all surface-mounted items. Blocking shall be provided and installed as recommended by the Manufacturer of the product to be mounted on the wall. Blocking shall be installed in new walls for, but not limited to, the following items:

- Wall-mounted or base-mounted door stops
- Fire extinguisher cabinets

MISCELLANEOUS PLYWOOD

Miscellaneous Concealed Plywood: C-C plugged exterior.

Miscellaneous Exposed Plywood: A-D interior.

Electrical/Telephone Backing Panels: C-D Plugged, Exposure 1 plywood, fire-retardant treated, ¾-inch thick.

MISCELLANEOUS MATERIALS

Fasteners and anchorages shall be of the size, type, material and finish as indicated below or on the Drawings and as recommended by applicable standards complying with applicable Federal Specifications for nails, (staples), screws, bolts, nuts, washers and anchoring devices. Metal Anchors shall be of the size and type recommended by the manufacturer for each use. Where rough carpentry work is exposed to the weather, in ground contact, or in areas of high humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

Miscellaneous Fastenings. Spikes, screws, lag bolts, and other miscellaneous fastenings and rough hardware shall be as shown on the Drawings, or as required to assemble and secure rough carpentry items. All fasteners associated with exterior work shall be galvanized finished, except that fasteners for redwood shall be stainless steel or aluminum.

Adhesives shall conform with Specification AFG-01 of the American Plywood Association.

C. EXECUTION

MISCELLANEOUS WOOD BLOCKING

Erect miscellaneous blocking as shown on the Drawings or as required to secure materials to rough construction.

Anchoring of blocking to steel or concrete shall be by bolted connections. Bolts shall be 1/2" diameter located 12" from each end and at 4' centers maximum, unless otherwise shown on the Drawings or specified herein.

INSTALLATION OF TREATED WOOD

Field cuts shall be coated with a concentrated solution of preservative treatment. Treated lumber shall be anchored in place as specified earlier in this section for blocking unless shown otherwise on the Drawings.

SECTION 06 30 00
WOOD TREATMENT

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Installation of Treated Rough Carpentry Materials	Section 06 10 00

ACCEPTABLE MANUFACTURERS

Acceptable manufacturers are those listed by the American Wood Preservers Bureau in their current directory as suppliers of pressure-treated wood products.

QUALITY MARK

Each piece of lumber which is pressure treated shall bear the American Wood Preservers Bureau Quality Mark to indicate conformance with the AWPB Standard specified later in this section. The information required by the American Wood Preservers Bureau Standard must appear on the label.

DELIVERY, STORAGE AND HANDLING

Store pressure-treated lumber indoors, if possible, or on a raised platform under waterproof coverings.

B. PRODUCTS

FIRE RETARDANT TREATMENT

All fire retardant treatment shall comply with applicable requirements of AWPA Standards C20 (Lumber) and C27 (Plywood) and of AWPB Standards listed below. Mark each treated item with AWPB Quality Mark Requirement. Fire retardant-treat items listed below with water-borne preservative to achieve flame spread of 25 or less when tested under ASTM E 84, NFPA 255 or UL 723. After treatment, kiln-dry to a maximum moisture content of 19%.

LUMBER REQUIRING FIRE RETARDANT TREATMENT

Rough carpentry materials for fire retardant resistant pressure treatment shall consist of the following materials:

1. Plywood mounting boards for electrical, telephone and communication equipment.
2. Wood framing and blocking above ceilings and soffits, except where such blocking is separated from above-ceiling spaces by a fire-rated gypsum board system.

ON-SITE TREATMENT

Cuts resulting from site fabrication shall be liberally coated with a concentrated solution of the preservative.

C. EXECUTION

INSTALLATION

Installation of treated wood shall be as specified in Section 06 10 00, Rough Carpentry.

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

SECTION 07 20 00
BUILDING INSULATION

A. GENERAL

QUALITY ASSURANCE

All insulating materials and methods of installation shall comply with all applicable building and fire codes.

PRODUCT DELIVERY, STORAGE AND HANDLING

Protect insulation from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with the manufacturer's recommendations for handling, storage and protection during installation.

B. PRODUCTS

BATT INSULATION

Thermal batt insulation shall be glass fibers formed with binders into resilient semi-rigid batts with integral foil vapor barrier (perm rating of 1.0 or less) laminated to the one face with 1" flanges on long edges. Batt insulation shall be the manufacturer's standard lengths and widths as required to coordinate with spaces to be insulated and shall have installed resistance of R-19 at 6" studs, R-13 at 3 5/8" studs, and shall be one of the following types and manufacturers (or approved equal):

FS-25 Building Insulation	Owens-Corning Fiberglass
FSK-25 Batt Insulation	Manville Corporation

At the Contractor's option, where insulation is covered by GWB, in lieu of taping the vapor barrier joints, he may use unfaced insulation covered by a 4-mil polyethylene vapor barrier (with a laboratory-tested vapor transmission rating of 0.2 perms) and the GWB.

Batt insulation shall be widths as required to tightly fit between studs, except that at all locations where gypsum drywall is not shown on both sides of the partition, batts shall be supplied with foil on one face and stapling flanges for fastening the insulation in place.

Batt insulation shall have maximum flame spread rating of 5 and smoke-developed rating of 15 per ASTM E 84. Where batt insulation is included in rated wall, ceiling or floor construction, provide mineral wool batts which have been tested and rated as required for the indicated assembly.

MISCELLANEOUS INSULATION MATERIALS

Fire resistive safing insulation for use at fire-rated or smoke stop partitions as shown on the Drawings shall be Thermafiber Safing insulation manufactured by United States Gypsum or Cafco Safing Insulating manufactured by United States Mineral Products Company.

Miscellaneous items, including mechanical fastenings and other accessories, shall meet the recommendations of the insulation manufacturer and the vapor barrier manufacturer, and shall comply with fire-resistance requirements.

Pressure-sensitive tape shall be Zero Perm, 1 1/2" wide tape, manufactured by Alumiseal Corporation, and shall consist of aluminum foil 1.0 mils thick, laminated between two sheets of polyester film, with a vapor transmission of 0.0134 perms or less in any condition, and with a permanent pressure-sensitive adhesive on one face.

C. EXECUTION

Clean substrate of substances harmful to insulations or vapor barriers, including removal of projections which might puncture vapor barrier.

GENERAL

Comply with manufacturer's written instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.

Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill and close voids with insulation.

Tape joints and ruptures in vapor barriers, and seal each continuous area of insulation to surrounding construction to ensure vapor-tight installation.

INSTALLATION OF BATT INSULATION

Install batt insulation at the locations as shown on the Drawings with vapor barriers on room or warm side. Tightly fit into place and push down in vertical spaces to assure avoidance of future settling. Securely staple in place as recommended by the insulation manufacturer. Tape all joints and perimeter in place to form a continuous vapor barrier. Maintain all required minimum clearance between insulation and fans, lights or other heat-producing equipment items. At locations where studs are less than full stud depth, strip part of the insulation off of the non-vapor barrier side to reduce the total thickness to 1/2" greater than the available space.

INSTALLATION OF FIRE RESISTIVE SAFING INSULATION

Install fire resistive insulation at the top of all fire rated walls and smoke partitions. Mechanical and Electrical Subcontractors shall be responsible to seal around miscellaneous openings through these walls for pipes, ducts, structure, etc.

PROTECTION

Protect installed insulation and vapor barriers from harmful weather exposures and from possible physical abuses, where possible by non-delayed installation of concealing work or, where that is not possible, by temporary covering or enclosure. Installer shall advise Contractor of exposure hazards, including possible sources of deterioration and fire hazards.

SECTION 07 92 00
JOINT SEALERS

A. GENERAL

RELATED WORK ELSEWHERE

Expansion joint filler for concrete slabs	Section 03 15 00
Joint sealers in mechanical work, including caulking around plumbing fixtures	Divisions 22 & 23
Joint sealers in electrical work	Division 26, 27 & 28

SUBMITTALS

Color samples shall be submitted in accordance with Section 01000. Samples shall be strips of actual caulking. Paper samples will not be acceptable.

GENERAL PERFORMANCE

Joint sealers, except as otherwise indicated, are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicated for each application. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.

JOB CONDITIONS

Sealants shall be installed on dry days preferably with temperatures between 40 deg. F and 55 def. F, but in no case shall sealants be installed when temperatures are below 40 deg. F or above 90 deg. F.

Special care shall be exercised to prevent damage to adjacent work during installation of sealants.

Sequencing

1. Install sealant adjacent to painted surfaces before adjacent surfaces receive their final coat of paint.
2. Caulking shall not begin until all samples have been approved.

B. PRODUCTS

SEALANTS

Sealant (caulking) for all interior applications shall be two-part polyurethane sealant and shall be one of the following or approved equal:

Sonolastic NP-2	Sonneborn
Dynatrol II	Pecora Corporation
Dymeric 240	Tremco Manufacturing Co.
Sikaflex-2C NSEZ Mix	Sika Corporation

Sealant (caulking) for all exterior applications shall be one part silicone sealant and shall be the following or equal products by Pecora, Sonneborn, Tremco, or approved equal:

795 Silicone Building Sealant	Dow Corning Corporation

Firestopping sealant for use at all penetrations through fire rated walls and at tops of such walls shall be CP25WB Sealant, MPS-2 and MMP-4S putty and other accessories as manufactured by 3M Corp., or equivalent products manufactured by Rectorseal Corporation, Bio Fireshield, Tremco, Specified Technologies, Johns Manville, or United States Gypsum Co. Provide proper product at each appropriate location.

Provide the sealant manufacturer's recommended type of joint primer for joint surfaces to be primed. Verify with the sealant manufacturers which materials require priming for each of the sealants used.

Backer rod shall be polyethylene rod, of a diameter 1/8" greater than the joint width up to 3/4" diameter and 1"

diameter for 3/4" wide joints. Composition of rod shall be determined by the sealant manufacturer for the particular substrate receiving sealant.

Bond breaker, where required to break the bond between sealant and the back-up material or joint filler, shall be a tape material recommended by the sealant manufacturer, or shall be polyethylene film.

C. EXECUTION

INSPECTION

Installer must examine substrates (joint surfaces) and conditions under which joint sealer work is to be performed, and must notify Contractor in writing of unsatisfactory conditions. Do not proceed with joint sealer work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

PREPARATION

Clean down joint surfaces using oil-free solvent for metal, glass, and other non-porous surfaces, and by wire brushing concrete and masonry surfaces. Surfaces to receive sealant shall be sound, clean and dry, and free of frost, laitance, curing compounds, waterproofing compounds, mastic compounds, corrosion, mill scale, rust, oil, tar, wax, paint, mastic, and similar contaminates.

Sandblast concrete in contact with form release agents.

Prime concrete, masonry, wood and similar porous surfaces. Brush out excess material to insure a uniform film over the joint face. Allow primer to dry out before applying sealant.

Mask adjacent areas as necessary to obtain a neat sealant line.

INSTALLATION

Comply with the manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

Mix two-part sealants by mixing the activator with the resin uniformly and thoroughly, in the proportions supplied to meet the recommendations of the sealant manufacturer. Sealant shall be mixed in a mechanical mixer, except very small amounts may be hand mixed with a trowel.

Install backer rod with a blunt rod or plain faced roller. Recess into joint to meet the sealant manufacturer's recommendations for joint width and depth ratio. Do not puncture, fold, twist, or crease backer rod.

Install bond breaker where sealant would otherwise bond to backer rod or joint filler.

Do not allow sealants or compounds to overflow from confines of joints, to spill onto adjoining work, or to migrate into voids of exposed finishes. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

Install sealants in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface slightly below adjoining surfaces.

Where horizontal joints are between the horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

Apply sealants by holding the gun nozzle at an angle of about 45 degrees and move steadily along the joint so that a uniform bead is applied without dragging, tearing, or leaving unfilled spaces. Push the bead rather than draw it with the gun leading. Fill joints in vertical surfaces level with adjacent surfaces and tool within ten minutes of application with one continuous stroke to insure intimate contact with the joint surfaces, to remove any trapped air or voids, to consolidate material, and to provide a neat, uniform, appearance. Fill joints in horizontal surfaces holding the top surface of the sealant slightly below the adjacent surfaces.

Install self-leveling sealants to a depth equal to 75 percent of joint width but neither more than 5/8-inch deep or less than 3/8-inch deep as recommended by sealant manufacturer. Pour sealant into joints and fill to within 1/16-inch of adjacent surfaces, exercising care not to spill sealant on such surfaces. Refill any areas where sealant seeps out of joint through the expansion joint filler before sealant sets up.

CLEANING AND PROTECTION

Remove masking immediately after application and tooling operations are complete. Clean excess or spilled sealant from non-porous surfaces with solvent before curing. Clean excess or spilled sealant from porous surfaces with abrasive or mechanical means after curing.

Protect sealant where bituminous material is to be applied over thermosetting joint sealant with vinyl or polyethylene sheet material.

Cure sealants in compliance with manufacturer's written instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Advise Contractor of procedures required for cure and protection of joint sealers during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of Substantial Completion. Replace or restore sealants which are damaged or deteriorated during construction period.

SCHEDULE OF APPLICATION

Apply sealant at the following locations:

At framed openings at interior walls where caulking is shown on the Drawings
At all exposed isolation, expansion, and control joints
At miscellaneous locations where caulking is shown on the Drawings

Apply firestopping sealants at the following locations, where required by code, and where indicated on the Drawings:

- Penetrations through fire-resistance-rated walls including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
- Penetrations through smoke-resistance walls and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
- Closing head of wall space at fire-resistant-rated walls and partitions, including both empty openings and openings being penetrated.
- Sealant joints in fire-resistance-rated construction.

SCHEDULE OF SPECIAL SEALANT COLORS

Special sealant colors shall match Tremco colors as follows:

At joints between GWB and painted masonry, concrete or steel	Match wall color
At perimeter of all new door frames	Match frame color
At miscellaneous locations shown on the Drawings	Standard color to most closely match adjacent colors

DIVISION 8 - DOORS AND WINDOWS

SECTION 08 11 13
METAL DOORS AND FRAMES

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Caulking and sealants	Section 07 92 00
Hardware, including silencers	Section 08 71 00
Grouting of frames in metal stud walls	Section 09 29 00
Bracing of frame heads in metal stud walls	Section 09 29 00
Painting	Section 09 90 00

SCOPE

Provide all labor, materials, tools, and equipment necessary for the furnishing and installation, complete, of all hollow metal doors and frames as shown on the Drawings or specified, in accordance with the provisions of the Contract Documents and completely coordinated with that of all other trades.

Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation.

QUALITY ASSURANCE

Hollow metal doors and frames shall be supplied by a single source supplier of all door hardware, hollow metal doors and frames. Suppliers shall be responsible for all coordination and preparation of products as they relate to each other.

Specified gauges of metals in doors, frames and reinforcing, and specified sizes, locations and extent of reinforcing will prevail in any case of conflict with industry standards.

Doors and frames shall comply with the Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified. Doors and frames shall also comply with American Society for Testing and Materials (ASTM), Door and Hardware Institute standards, and National Fire Protection Association (NFPA) as they may apply to this project.

HARDWARE TEMPLATES

Hardware templates shall be furnished to the fabricator by the hardware manufacturer. The fabricator shall drill and tap all holes, and make all cutouts and reinforcements in frames and doors to receive hardware in a neat and proper manner.

REQUIREMENTS OF REGULATORY AGENCIES

Where noted or shown on the Drawings, furnish doors and/or frames bearing the label of Underwriters Laboratories or FM Global, indicating the applicable rating and wall opening classification specified.

SUBMITTALS

Submit Shop Drawings in accordance with Section 01000. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

Provide schedule of doors and frames using same reference numbers for details and openings as those on the Drawings.

DELIVERY, STORAGE AND HANDLING

Doors shall be shipped individually packed. Frames shall be shipped with angle spreaders at door opening bottoms. Doors and frames shall be stored on the building site, in an upright position, under cover, on wood sills or floors, in a manner that will prevent rust or damage. Ventilate canvas or plastic to prevent moisture traps.

Inspect hollow metal work upon delivery for damage. Minor damage may be repaired provided items are equal in all respects to new work and acceptable to the Government Construction Representative. Rejected work shall be replaced with new items.

B. PRODUCTS

MATERIALS

Steel sheets shall be cold-rolled, commercial quality carbon steel complying with ASTM A 366 and ASTM A 568.

Fabricate supports and anchors of not less than 18-gauge galvanized sheet steel unless otherwise noted.

Inserts, bolts and fasteners shall be the manufacturer's standard units complying with ASTM A 153, Class C or D as applicable.

Shop-applied primer for all doors, frames, and related accessories shall be rust-inhibitive enamel or paint, either air-dried or baked, suitable as a base for specified finish paints listed in Section 09 90 00.

Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

HOLLOW METAL DOORS - FULL FLUSH TYPE

Face sheets shall be 16-gauge cold-rolled stretcher-leveled steel internally welded to steel stiffeners of sufficient strength and spacing to support the face sheets against impact and to assure flat face sheet surfaces, or shall be bonded to a rigid polystyrene or polyurethane core. If steel stiffeners are used, doors shall be filled with mineral rock wool or fiberglass.

Vertical edges shall be minimum 16-gauge continuous channels (12-gauge continuous "C" channels with minimum 3/16-inch thread depth or 3/16-inch x 12-inch continuous steel plate at hinge edges from top to bottom of door) with each face sheet wrapped around the channels meeting at the center of the edge, with the resulting seam closed, welded, ground smooth, filled and finished, or continuously welded and ground smooth. If edges are not continuously welded, provide hinge reinforcing at all hinges equal to Steelcraft's high frequency hinge reinforcement. Provide 1/8-inch bevel on lock edge of door. Provide square edges on hinge edges of door. Non-handed doors will not be permitted.

Top and bottom edges shall be 14 or 16-gauge continuous steel channels. Back of channel shall align with the top of face sheets and shall be smooth and flush. Flush plastic filler caps may be used in lieu of metal channel top closure. Inverted channels (legs down) shall be used as door bottoms.

HOLLOW METAL FRAMES

Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings of types and styles as shown on the Drawings and Schedules. Conceal fastenings, unless otherwise indicated.

Fabricate frames and associated members from 14-gauge cold-rolled steel.

Frame corners for the three-sided door frames shall be die-mitered with frame face continuously welded and ground smooth. Continuously back weld soffit and rabbets. Frame corners for transom, sidelight, and borrowed light frames shall be saw-mitered or butt joint. Intermediate rail connections shall be coped and let into adjacent members and all corners and connections shall be face welded and ground smooth.

Prepare stops to receive three door silencers on strike jambs of frames on single-leaf doors and two silencers on heads of frames on double-leaf doors. Silencers shall be type GJ64 manufactured by Glynn Johnson. Silencers

shall not be omitted at doors scheduled to receive sound strips or weatherstripping. Silencers shall be furnished under Section 08 71 00.

Stops shall be 5/8-inch high unless noted otherwise on the Drawings or required to achieve specified fire ratings.

Jamb anchors shall be adjustable, 16-gauge corrugated steel, permanently fastened to the frame for setting into masonry partitions, or standard steel stud anchors for metal stud/gypsum board partitions. Each jamb shall be anchored to the floor with an adjustable base anchor. Other types of anchors shall be provided when required for other conditions. Provide a minimum of three anchors per jamb for frames up to 90 inches high and four anchors per jamb for frames over 90 inches high.

FABRICATION

Fabricate metal doors and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant.

Welds shall be ground invisible and depressions shall be filled smooth.

Undercut doors 3/4-inch to clear carpet where carpet is indicated in the Room Finish Schedule. Pay particular attention to varying heights of different thresholds when setting door undercuts.

MISCELLANEOUS ITEMS

Fabricate special shapes for special conditions as shown on the Drawings, and all special head, jamb or sill anchors as may be shown on the Drawings or otherwise required for a complete installation. These items shall be fabricated from 14-gauge steel unless noted otherwise.

FINISH HARDWARE PREPARATION

Prepare doors and frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with the applicable requirements of ANSI A115 Series Specifications for door and frame preparation for hardware.

Doors and frames shall be mortised, reinforced, drilled and tapped for scheduled mortised hardware.

Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.

FRAME HINGE REINFORCEMENT

Provide high-frequency hinge reinforcement at top hinges.

DOOR REINFORCEMENT FOR ALL DOORS

Closer/Holder/Overhead Stop	Minimum 12-gauge tubular 5-inch x 18-inch length, or as required.

ADDITIONAL FRAME REQUIREMENTS

1. Install 1-inch x 2-inch x length required foam insulation where grouted frames must be penetrated by machine or sheet metal screws for attachment of closers, rim panic strikes, or jamb up weatherstrip. Attach securely with tape or adhesive as required.
2. Plaster guard covers shall be welded in place over all drilled reinforcements of frames.

SHOP PAINTING

Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

Apply shop coat of prime paint of even consistency to all doors and frames to provide a uniform and smooth finished surface ready to receive finish paint, including back surfaces of all frames.

C. EXECUTION

INSPECTION

Examine substrate and conditions under which metal doors and frames are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

INSTALLATION

Comply with provisions of SDI-105 "Recommended Erection Instructions for Steel Frames," unless otherwise indicated. Place frames prior to construction of enclosing walls and ceilings. After wall construction is completed, remove temporary braces, and spreaders, leaving surfaces smooth and undamaged.

At new sills and thresholds installed on existing floor materials, level existing materials with grout as required to make proper substrate for installation of new sill or threshold.

Install frames accurately in position, plumbed and aligned to Door and Hardware Institute standards, and braced securely until permanent anchors are set. Anchor frames securely to floor and at jambs. Furnish necessary clips, fastenings and anchorages, and conceal unless otherwise noted. Weld all field joints, grind smooth, and fill with body putty to completely conceal seams and to form a smooth, unbroken finish surface.

Spot grout at all jambs of frames set into metal stud construction; this work is included under Section 09 29 00. Grout full and solid all jambs of frames set into masonry construction; this work is included under Section 04 20 00.

Where frames are anchored with bolts, bolts shall be countersunk, and surfaces shall be made smooth with putty.

Install fire-rated frames in accordance with NFPA Standard No. 80.

At the Contractor's option, at conditions where new frames are to be installed in existing masonry walls, frame jambs and heads may be installed using the following method:

- Grout new frame full prior to installation in wall.
- Install frame in opening, anchoring with countersunk anchors through frame face, and body putty over anchors.
- Tuck point (with grout) the frame perimeter between frame face and wall construction, holding grout back 1" from faces for caulk (caulk under Section 07 92 00).

DOOR INSTALLATION

Fit hollow metal doors accurately in frames, within clearances specified in SDI-100 with doors plumb and true without hinge binding.

ADJUST AND CLEAN

Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer, paying particular attention to bottom of frames at the floor line.

Check and readjust operating finish hardware items, leaving metal doors and frames undamaged and in complete and proper operating condition.

SECTION 08 71 00
HARDWARE AND SPECIALTIES

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Metal Doors and Frames	Section 08 11 13

GENERAL REQUIREMENTS

Supply all items of finish hardware and related services necessary for the proper functioning of all doors, and for such other requirements as are designated under this Section.

QUALITY ASSURANCE

The firm supplying hardware for this project shall employ a member of the American Society of Architectural Hardware Consultants, or a person of equivalent capability, who shall be available during construction for consultation and technical assistance.

The hardware supplier shall coordinate all hardware items to be installed in or on metal doors and frames with the supplier of those items to assure proper fit, reinforcing and operation.

Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware which has been tested and listed by UL or FM Global for types and sizes of doors required and complies with requirements of door and door frame labels.

SUBMITTALS

Submit Hardware Schedule in accordance with Section 01000. The Hardware Schedule shall list the type, manufacturer's name and number, finish and location. All abbreviations and symbols used on the Schedule shall be explained. No hardware shall be ordered, or delivered to the job, until approval of the schedule has been received from the Contracting Officer. Approval of the schedule does not relieve the hardware supplier of fulfilling all terms of the Specifications.

Supply copies of installation instructions, maintenance instructions for each operating item, maintenance instructions for finishes, and parts manuals for all locksets, closers, exit devices and other operating devices to the Contractor for inclusion in the overall project Maintenance Manual per Section 01000.

Supply complete sets of all installation and adjustment tools for transmittal to the Contracting Officer for each different style, type and series of lockset, latch, lock, exit device, closer or other adjustable hardware item provided and installed at this project per Section 01000.

Verify keyway requirements and establish core mark, control, grand master, master, submaster divisions and individual passage keying requirements with the Contracting Officer. Verification shall include keying for miscellaneous locks on other items listed at the beginning of this Section. Submit separate detailed schedule indicating clearly how the final instructions to the Contracting Officer on keying of locks have been fulfilled.

SUBMITTAL SEQUENCE

Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., metal doors and frames), which are critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by builders of hardware, and other information essential to the coordinated review of hardware schedule.

Hardware for installation on metal doors and frames shall be made to standard templates, and such templates, schedules and other pertinent information shall be delivered to the individual door and frame fabricators within ten days after receipt of the approved Finish Hardware Schedule. All metal doors and frames shall be reinforced, drilled, and tapped by the fabricator for mortised hardware. Reinforcement for surface-applied hardware shall be

by the fabricators. Drilling and tapping shall be done in the field by the hardware installer for surface-applied hardware items.

PRODUCT HANDLING

Package hardware in individual containers on a set-by-set basis with set numbers that correspond to the approved hardware schedule. Each set shall contain each item of hardware required for that set including necessary screws, keys and installation instructions, and installation templates for spotting mortising tools. Two or more identical sets may be packaged in the same container. Mark each container clearly with hardware set numbers. All keys shall be tagged according to their corresponding locks and delivered to the Contracting Officer as described hereinafter. All construction keys shall be delivered to the Contractor.

B. PRODUCTS

HARDWARE

Finish hardware shall be as hereinafter specified and scheduled. Provide additional items of hardware, which are necessary to make a complete workmanlike installation even though such items are not specified. Such miscellaneous items shall be equal in quality to items which are specified.

Brands and models designated in this Section are intended to define the exact standards of quality, function and design required. Substitution will not be permitted unless given written approval by the Contracting Officer.

ITEM	SPECIFIED	ACCEPTABLE
Hinges	Stanley	Hager, McKinney
Locks	Best	Corbin Russwin, Schlage (Must accept Best cores)
Cylinders/Cores	Best	No Substitutions
Closers	Norton	LCN 4040 EDA, Stanley D-4550 EDA
Flat Goods &Stops	Rockwood	Trimco, Ives
	Kick Plates 8" x 2" L.D.W. x .050	US32D
	Wall Stops #403	US26D
Surface Bolts	Rockwood	Ives

*Provide S88D perimeter gasket at fire-rated doors. Provide appropriate meeting stile strips at pairs.

KEYING

All locks shall be keyed in the factory registered system previously established for this building; supply 4 keys for each master and sub-master division, and 2 passage keys per lock.

Keying arrangements and requirements for all new locks shall be coordinated directly between the hardware supplier and the Contracting Officer.

After locks are installed, deliver cores and keys directly to the Contracting Officer direct from the manufacturer via registered mail.

Conversion from construction keying to permanent building keying shall be performed by the Government. The hardware subcontractor shall be available to assist the Contracting Officer as necessary. The final cores and keys for all locks shall be shipped directly to the Contracting Officer who will install them on all door locks and other miscellaneous items listed later in this section. The cost of all cores and keys shall be included in this Combined Contract.

MISCELLANEOUS

Hardware shall have the following U.S. Standard finishes:

1. US26D or US32D for all items unless otherwise specified.
2. AL finish for exposed surfaces of door closers unless otherwise noted.
3. Similar finishes for all other items unless otherwise noted.

All doors over 36-inches wide will require 5-inch high butts.

Closers on all doors shall be mounted with sex bolts and finishing washers. Grommet nuts will not be acceptable. Provide mounting plates where required. Closers shall be of the parallel arm configuration where possible. Closer arms shall be heavy-duty type for all closers.

Fabricate door plates from 0.50-inch thick metal, drilled and countersunk for field mounting, furnished with matching finish oval head screws suitable for door material construction.

All metal frames shall receive Glynn Johnson GJ64 silencers as required. Provide three silencers on strike jambs of frames of single swing doors and two silencers on heads of frames of double-swing doors.

Dead stop angles for closers and overhead stops shall be accurately determined to prevent doors from contacting adjoining walls or other doors while still effecting the hold-open point at the greatest possible angle.

Supply correct wall stop anchors to coordinate with the wall construction. Wall stops installed on stud walls must be screwed into wood blocking installed within the wall under Section 06 10 00.

C. EXECUTION

HARDWARE LOCATIONS

Hardware locations (height above finish floor) shall be as follows:

Levers	40” to centerline

INSTALLATION OF HARDWARE

GENERAL

Install each hardware item in compliance with the manufacturer's written instructions. Wherever cutting and fitting is required to install hardware onto or into surfaces, which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division 9 sections. Do not install surface-mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill, tap and countersink units for surface-applied hardware and other items which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards and manufacturer's recommendations.

INSTALLATION OF SEALS

Provide metal fasteners of type which will not work loose as a result of normal door use, and which are compatible with metal of the stripping, the frame or the door. Provide only smooth exposed fastener heads, which do not constitute a snagging hazard to clothing of building occupants.

Set units plumb and level, accurately centered at optimum location for maintaining a permanent seal.

Adjust doors, frames and hardware, as necessary, to achieve proper operation of seals and stripping.

ADJUST AND CLEAN

Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace any unit which cannot be adjusted to operate freely and smoothly as intended for the application made.

HARDWARE SCHEDULE

HARDWARE SET NO. 1

1 ½	Pairs	Hinges	FBB179	4 ½" x 4 ½"	US26D
1	Each	Passage Set	93K 0N 15D		626
1	Each	Wall Stop			

HARDWARE SET NO. 2

1 ½	Pairs	Hinges	FBB179	4 ½" x 4 ½"	US26D
1	Each	Lockset	93K 7D 15D		626
1	Each	Closer	CLP7500		689
1	Each	Kickplate			

HARDWARE SET NO. 3

3	Pairs	Hinges	FBB179	4 ½" x 4 ½"	US26D
4	Each	Surface Bolts	580-12		US26D
1	Each	Threshold	171A		
1	Set	Sound Seal	312CR		
2	Each	Sweep	315CN		
1	Each	Astragal	375CR		

HARDWARE SET NO. 4

1 ½	Pairs	Hinges	FBB168	5" x 4 ½"	US26D
1	Each	Lockset	93K 7D 15D		626
1	Each	Closer	CLP7500		689
1	Each	Kickplate			

DIVISION 9 - FINISHES

SECTION 09 06 90
COLOR SCHEDULE

MATERIALS LIST AND COLOR SCHEDULE

- Vinyl Base per Section 09 65 00, RESILIENT FLOORING:
  1. VB-1 (4" coved)
     Manufacturer: Johnsonite
     Color: Burnt Umber

- Vinyl Composition Tile Per Section 09 65 00, RESILIENT FLOORING:
  1. VCT-1
     Manufacturer: Armstrong
     Style: Imperial Texture Standard Excelon
     Color: 51810 Washed Linen
     Size: 12" x 12"

- Paint per Section 09 90 00, PAINTING:

	Manufacturer	Color Name / Number
P-1	Sherwin Williams	SW6078 Realist Beige
P-2	Match existing wall color in Room 106	
P-3	Sherwin Williams	SW6005 Folkstone

COLOR PLACEMENT

1. The following lists of items requiring painting or staining contains the major areas of finish required. Contractor shall verify the color and type of finish with the Government Construction Representative for any items which obviously require finish, but for which a paint or stain color is not listed hereinafter.

2. Exterior Color Placement:

Pre-finished metal generator enclosure	No work

3. Interior Color Placement:

Walls and ceilings	See Drawings
Hollow metal doors and frames except as noted below	P-3
Hollow metal door and frame at Door 8A	P-2
New steel door lintels	P-1
Air diffusers, grilles and similar items in finished walls and GWB ceilings	Paint to match adjacent wall or ceiling (unless prefinished to match wall or ceiling)
Wall access doors and electrical panels	No Work

SECTION 09 29 00
GYPSUM DRYWALL

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Insulation to seal around penetrations and abutments to adjacent surfaces at gypsum drywall portions of fire, smoke, and sound partitions	Section 07 20 00
Acoustical treatment	Section 09 51 00

QUALITY ASSURANCE

Where gypsum wallboard systems with fire-resistance ratings or smoke partitions are indicated or are required to comply with governing regulations, provide materials and installations identical with applicable assemblies which have been tested and rated by UL (Underwriters Laboratories, Inc.) or other industry recognized agency.

On faces of work exposed in occupied spaces, limit offsets between planes of board faces to 1/8-inch, and limit variations from plumb and location (including warp and bow) not to exceed 1/4-inch in 8'-0".

DELIVERY, STORAGE AND HANDLING

Gypsum drywall shall not be delivered to the project site until immediately before application begins. All gypsum drywall materials shall be delivered in original packages, containers or bundles bearing brand name and identification nomenclature.

Gypsum drywall shall be stored inside under cover and stacked flat in a manner to keep material flat, dry, protected from weather, direct sunlight, surface contamination, traffic or other construction damage. Other materials and accessories shall remain in their original wrappings or containers, stored flat and protected from weather damage and bending until ready for actual use.

Handle materials in a manner to prevent damage to edges, ends or surfaces. Damaged materials or accessories shall not be incorporated within the work and shall be immediately removed from the site.

JOB CONDITIONS

Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum board.

B. PRODUCTS

METAL STUDS

The cold-formed structural framing shall be manufactured from steel that corresponds to the minimum requirements of 1996 A.I.S.I. standards. The steel shall have a minimum yield strength of 33 ksi for all design thicknesses, or optional 50 ksi for 54 mil (16 Ga.) and heavier members, and shall have minimum protective coating equal to G-60 galvanized finish. See Drawings for specific stud sizing. The metal stud framing shall be provided by one of the following (or approved equal):

- Dale Industries, Inc.
- National Gypsum Company (Gold Bond)
- United States Gypsum
- Dietrich Industries
- Clark Steel Framing
- Unimast, Inc.
- Marino Industries Corp.

25-gauge studs shall be used throughout for interior applications, except 20-gauge shall be used at all 3 5/8" interior studs that are over 12-feet total height. Such studs shall be braced laterally at a maximum height of 12-feet as described hereinafter.

Slip runner track shall be 20-gauge galvanized steel channel track of a width to fit over metal stud tracks specified above and with 3-inch minimum legs placed at the top of all walls abutting structural members above as indicated on the Drawings.

Galvanizing repair paint shall be one of the following or approved equal:

- Tnemec zinc rich primer
- Carboline 658 zinc filled epoxy primer
- Ameron Amercoat 68HS
- Devoe Coatings 303H

GYPSUM BOARD

Gypsum board for fire-rated ceilings and walls and smoke stop partitions (both sides), where noted on the Drawings, shall be 5/8" thick (unless noted otherwise on the Drawings) with tapered edges, and shall be one of the following (or approved equal):

G-P Firestop Gypsum Board	Georgia-Pacific
Gold Bond Fireshield Gypsum Wallboard	National Gypsum Co.
Sheetrock Firecode Gypsum Panels	United States Gypsum

All other gypsum board shall conform to ASTM C36, shall be 5/8-inch thick (unless noted otherwise on the Drawings) regular board with tapered edges, and shall be one of the following (or approved equal):

G-P Regular Board	Georgia-Pacific
Gold Bond Regular Gypsum Wallboard	National Gypsum
Sheetrock Regular Gypsum Panels	United States Gypsum

ACCESSORIES AND MISCELLANEOUS MATERIALS

Casing beads shall be Type 801-A metal trim manufactured by U.S. Gypsum or equal for installation with the fine mesh on the exposed face.

Corner beads shall be Type 800 corner beads manufactured by U.S. Gypsum or equal for installation with the fine mesh on the exposed face.

Control joints shall be formed by installing two (2) casing beads back-to-back with 1/16-inch gap in between, or by using a ¼" wide by 7/16" deep vee-shaped trim with fine mesh on the exposed face.

Grout for all door frames which occur in stud walls shall be Durabond Joint Compound manufactured by United States Gypsum Company or equal.

JOINT TREATMENT

Joint treatment shall be paper reinforcing tape and ready-mixed vinyl-type compound by the same manufacturer as the wallboard, except use fiberglass tape at moisture-resistant GWB.

COMPRESSIBLE FILLER

Compressible filler for use at fire-rated or smoke partitions as indicated on the Drawings, to fill gaps between partitions and roof deck and/or structure and to close gaps around pipes, ducts, flues, and other penetrations and to fill gaps between gypsum board and other materials shall be Termafiber Safing Insulation manufactured by United States Gypsum as specified in Section 07 20 00.

FASTENERS

Screws shall be 1-inch, Type S, drywall screws for securing gypsum board to studs and furring channels. Longer screws, as recommended by the gypsum board manufacturer, shall be utilized to secure the exposed layer of gypsum board to the suspension system through the concealed layer at double layer ceilings or bulkheads.

Adhesive shall be Mastic No. 11 manufactured by Dow Corning Corporation unless other adhesive is recommended by the gypsum board manufacturer.

C. EXECUTION

INSTALLATION OF METAL STUDS

1. Install steel framing to comply with ASTM C 754 and ASTM C 840.
2. Align track at floor, top of masonry walls, frames and overhead structure as indicated on the Drawings. Secure base track at 24-inch centers and at ends with power-driven fasteners as specified above. Head track shall be held within the down-turn legs of specially formed 20-gauge galvanized steel slip runner track welded or secured to bottom side of structure above for lateral support with deflection allowance of 1/2-inch or as otherwise indicated on the Drawings. See information earlier in this Section for locations where the slip runner track is required at top of walls. Bulkhead or other similar construction which is to be hung under tension shall have head track secured to structure at 16-inch centers minimum. Butt weld or splice track at joints.
3. Set studs at partition ends, corners, and intersections; at jambs of openings and at 16-inch centers in between unless shown otherwise on the Drawings. Seat studs squarely into track and plumb or align. Secure studs to track as required. **Studs shall be doubled adjacent to all metal frame jambs whether shown on the Drawings or not.**
4. Where stud partitions exceed 15-feet in height, provide lateral bracing to the structure above so the unbraced height of the partition does not exceed 15 feet. If the studs are of sufficient length to extend full height without splicing, the studs shall be braced by attaching a horizontal runner channel to one face of the studs and extending diagonal 3 5/8" metal stud knee braces from that channel to the structure. Spacing of knee braces shall be a maximum of 8-feet on center.
5. If the partition is of such height that the studs must be spliced, do so by installing two horizontal runner channels back-to-back (one for the top of the lower wall and one for the bottom of the upper wall). Fasten the runner channels to each other and then install diagonal knee braces at 8-feet maximum centers as described above.
6. Install horizontal stiffener channels through studs at cut-out locations at maximum 6'-0" centers in partitions which do not have GWB installed in both faces.
7. Install knee braces for metal frames and for walls which terminate above the ceiling as required to provide lateral support.
8. At special slip runner tracks at tops of walls where deflection of the roof structure is anticipated, do not anchor GWB to slip runner track.
9. Track at floor shall be deep leg track.

GROUTING OF METAL FRAMES IN STUD WALLS

Grout all hollow metal frames which occur in stud walls by spot-grouting at the jamb anchor clips prior to inserting the gypsum board into the frame. Grout tightly to assure solid anchorage of the frame. Do not fill metal frame jambs full of grout.

INSTALLATION OF GYPSUM BOARD

Install and finish gypsum board to comply with ASTM C 840.

Apply gypsum board beginning with the top wall panel, butted against the deck. At walls with lip runner track, hold drywall down 5/8” below deck/structure. Apply panels of maximum practical length with long dimension at right angle to supports. Center vertical joints over supports and stagger them from those of adjacent panel rows. Vertical joints on opposite sides of a partition shall occur on different studs. Boards shall be brought into contact with each other, but shall not be forced into place.

End joints may occur not closer than 8 inches from either side of openings in walls. No joint shall align with edges of openings, and joints above openings shall be centered over openings.

Hold bottom edge of gypsum board off the floor by ½”.

Fastening panels shall be held in firm contact with the support member while the screws are being driven. Fastenings shall proceed from the central portion of the board toward ends and edges. Fastenings shall be driven home with the heads slightly below the surface of the board. Care shall be taken to avoid breaking the paper face. Improperly driven fastenings shall be removed. Space screws at 15-inch centers and locate 3/8-inch to 1/2-inch

from edges of panels. At double layer bulkheads, install finish layer with longer screws and adhesive as noted above for ceilings.

After installation, pound on walls and ceilings to detect loose fastenings and push on board adjacent to fasteners to see if there is movement. If loose fasteners are detected, drive them tight. Whenever fastenings have punctured paper, hold board tight against framing and install another fastener properly, approximately 1-1/2" from fastener head which punctured paper, and remove the faulty fastener. When fastening wallboard to second side of a partition, check the opposite side for fasteners loosened by pounding and drive them tight again.

INSTALLATION OF ACCESSORIES

Corner beads shall be applied at outside corners with fasteners at 3-inch centers maximum on each flange of bead with fasteners staggered.

Casing beads shall be applied to all exposed edges and ends of gypsum wallboard, back to back at control joint locations and wherever indicated on the Drawings, with fasteners at 6-inch centers.

Control joints shall be placed where shown on the Drawings in continuous lengths with back-to-back casing beads spaced with uniform 1/16" gap between backs. Gap shall be larger where shown on the Drawings at locations where wallcoverings are to be tucked into the joint.

COMPRESSIBLE FILLER

Completely fill all voids and gaps in and around the gypsum board at fire partitions, smoke partitions, and sound partitions. See description of these locations earlier in this Section. Tightly fit filler into these spaces to resist long-term displacement.

JOINT AND CORNER TREATMENT

A uniform, thin layer of joint compound shall be applied over the joint approximately 4 inches wide. Tape shall be centered over the joint and embedded into the compound, leaving sufficient joint compound under tape to provide proper bond. Inside corner angles shall be reinforced with tape folded to conform to the angle and embedded into the compound. Taping will be required where gypsum board is concealed above ceilings but joints will not need to be finished in such areas.

FINISHING

After compound is thoroughly dry, the tape shall be covered with a coat of joint compound or topping compound spread over the tape approximately 3 inches on each side of the tape and feathered out at the edge. After thoroughly dry, another coat of joint compound or topping compound shall be applied with a slight, uniform crown over the joint. This coat shall be smooth and the edges feathered approximately 3 inches beyond the preceding coat.

All inside corners shall be coated with at least one coat of joint compound or topping compound with the edges feathered out. Flanges of wallboard corner bead shall be concealed by at least two coats of compound. The first coat shall be joint compound, and the second coat may be joint compound or topping compound feathered out approximately 9 inches on both sides of the exposed metal nose.

Allow each application of compound to joint and fastener heads to dry, then sand if necessary. Caution shall be used to avoid roughing of wallboard paper. Where more than one compound coat is specified herein, allow 24 hours drying time between coats.

Provide the following levels of gypsum board finish per GA-214:

1. Level 1 for ceiling plenum areas and concealed areas, unless a higher level of finish is required for fire-resistant-rated assemblies and sound-rated assemblies.
2. Level 4 for exposed gypsum board surfaces. (No textured ceiling coatings will be allowed).

SECTION 09 65 00
RESILIENT FLOORING

A. GENERAL

QUALITY ASSURANCE

Provide each type of resilient flooring with accessories produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

The Contractor shall perform tests as necessary to determine if the concrete floor slab is within limits acceptable to resilient flooring manufacturer's recommendations for moisture and pH levels.

SUBMITTALS

Submit samples of vinyl tile, vinyl base and vinyl accessories in accordance with Section 01000.

EXTRA STOCK

Deliver to the Government, prior to the acceptance of the project, twelve (12) square feet of each vinyl tile scheduled and ten (10) lineal feet of each size and color of vinyl base and vinyl accessory scheduled.

DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in unbroken, sealed packages, with manufacturer's name and brand stamped thereon. Material shall not be stored in newly drywalled rooms or rooms otherwise exposed to dampness.

JOB CONDITIONS

Materials shall be maintained at a temperature of 70 deg. F for 48 or more hours before they are installed. A temperature of 70 deg. F or more shall be maintained in areas receiving resilient flooring materials for a period beginning 48 hours before application is begun and ending 48 hours after installation is complete.

Work shall not commence until after painting is completed. Vinyl base shall not be installed until after painting and flooring work is completed.

B. PRODUCTS

APPROVED MANUFACTURERS

Acceptable manufacturers are as follows (or approved equal):

- Armstrong World Industries
- Azrock Industries
- Tarket
- Mannington
- Fritztile

MATERIALS

See Section 09 06 00, Color Schedule.

Vinyl tile-to-bare concrete transition shall be No. RRS-XX reducer by Johnsonite. Color shall match vinyl base. Equivalent products by Mercer, Flexco or Roppe are also acceptable.

Primers, adhesives and cements shall be as approved by the manufacturer for the particular material with which they are used.

Floor filler, where required to properly level new and existing subfloor surfaces (at depressions 1/16" deep or less) prior to installation of floor finishes, shall be a latex-based filler of the type recommended and approved by the

resilient flooring and adhesive manufacturers. Compatability of floor filler with other previously-installed floor patching material is the responsibility of the Contractor.

Floor polish shall be as recommended by the resilient flooring manufacturer and shall conform to ASTM D 4078.

C. EXECUTION

INSPECTION AND PREPARATION

Contractor shall be responsible for the proper product installation, including floor preparation and moisture testing, in the areas indicated to receive resilient flooring. There shall be a minimum of three (3) calcium chloride tests performed on each floor level per ASTM F1869, which includes, but is not limited to, the following requirements: heating/cooling system must be fully operating to maintain temperature and relative humidity as it will be when building is fully occupied, concrete surfaces to be tested shall be cleaned with a gentle grinding prior to testing, and the ground areas must be left open for 24 hours before installing the test kits. If the emission rate is over 3.0 lbs., the Contracting Officer shall be notified.

Under this Section, the Contractor shall be responsible for installing fill in depressions, holes, cracks, and minor variations up to and including 1/16" vertical offsets.

Surfaces shall be free of grease, oil, paint, and foreign matter. Dust shall be removed by vacuum cleaning after a light sanding with a power disk floor machine with a course emery pad. Surfaces to receive resilient flooring shall be thoroughly clean and dry. The installation of resilient flooring shall be an indication of the Contractor's acceptance of the substrates, and he will automatically assume the responsibility for any unacceptable finished work caused by substrate conditions.

INSTALLATION OF FLOOR TILE

Lay out floor tile in stack bond pattern unless shown otherwise on the Drawings. Extend tile under counters and cabinets at knee spaces, into alcoves and appliance recesses adjacent to or within rooms scheduled to receive resilient flooring. Each tile shall be completely bedded in adhesive. Joints shall be as tight and inconspicuous as possible. Cutting and fitting shall be carefully and accurately done with no pieces less than 4" wide. Care shall be taken to prevent adhesive from showing on finished surfaces of floor, base or adjoining work. All such adhesives shall be promptly removed; otherwise damaged or stained material shall be replaced.

INSTALLATION OF VINYL BASE

Install vinyl base where scheduled, upon completion of the application of wall finishes and all flooring materials. Install vinyl base on all counter and vanity toe spaces and extend into alcoves and appliance recesses, on cabinet finished ends, and on exposed ends of vanities.

Vinyl base shall be installed in continuous lengths. Piecing will not be permitted. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness, heat and fold: no joints allowed within 2'-0" of corners. All vinyl base shall be secured to vertical surfaces with adhesive utilizing methods and materials recommended by the manufacturer. Exercise extreme care to avoid getting adhesive on exposed wall or floor surfaces. Heat vinyl base and/or use contact cement at corners where the return distance is not sufficient for secure and permanent anchorage. Roll with a hand roller to assure full adherence to the wall surfaces.

INSTALLATION OF ACCESSORIES

Accessories shall be located under door location, where possible.

CLEANING AND PROTECTION

Resilient flooring and base shall be cleaned thoroughly in accordance with the manufacturer's written maintenance recommendations. Polish resilient flooring with number of coats of floor polish as recommended by the resilient flooring manufacturer. After floors and base are finished, cleaned, and polished, all traffic shall be kept off floors for at least 48 hours.

SECTION 09 90 00
PAINTING

A. GENERAL

SCOPE

The scope and extent of painting and finishing shall be as designated by Specifications, Schedules and Drawing notations.

WORK NOT INCLUDED

Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated. See list of items later in this Section.

Moving parts of operating units, mechanical and electrical parts, such as valve and damper operations, linkages, sensing devices, motor and fan shafts will not require finish painting, unless otherwise indicated.

Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

Omit paint and/or finishing as noted for the following items:

- Stainless steel items
- Security cameras
- Finished mechanical and electrical equipment

QUALITY ASSURANCE

ACCEPTABLE MANUFACTURERS are as follows (or approved equal):

Benjamin Moore and Company
Diamond Vogel
ICI Dulux Paints
Kwal Paint
Pittsburgh Paints, PPG Industries, Inc.
Pratt and Lambert
Sherwin-Williams Company
Tnemec Co., Inc.

REVIEW OF PAINTING SCOPE BEFORE BIDDING

The Painting Contractor shall be responsible for performing all work and providing all materials required to achieve the design intent shown on these Drawings. The Government will not be responsible for any additional expense to the Contractor if the conditions causing those expenses could have been discovered in an on-site inspection prior to bid submittal.

SUBMITTALS

Submit samples of each type of finish and color in accordance with Section 01000. Paint samples shall be submitted on 8 1/2-inch x 11-inch Mead Mark I cover paper, coated on one side, with paint sprayed or applied with a foam rubber roller. Samples shall be submitted within 15 days after the Contract date. Back of paint samples shall show the paint manufacturer and the trade name of the proposed paint.

EXTRA STOCK

The Contractor shall furnish the Government with one gallon of each color or type of finish, sealed and unused, together with the mixing formula written on the cans. The Contractor shall also furnish two copies of this information to the Government in addition to the instructions attached to paint containers.

DELIVERY, STORAGE AND PROTECTION

All paints and similar materials shall be delivered in the original containers with seals unbroken and labels intact.

All materials used on the project shall be stored in a single place designated by the Government Construction Representative. Such storage place shall be kept neat and clean, and all damage thereto or to its surroundings shall be made good. Any oil, rags, waste, etc. shall be removed from the building every night, and every precaution taken to avoid the danger of fire.

JOB CONDITIONS

Surface temperature shall be maintained at the minimum temperature required by the paint manufacturer during application and drying of paints. Exterior surfaces shall not be painted or finished during weather period that are forbidden by the manufacturer's written instructions. See manufacturer's written instructions for more specific information.

Adjacent work, building finishes and surfaces shall be totally protected with masking tape, drop cloths or other suitable coverings.

B. PRODUCTS

MATERIALS

The Contractor shall have the option of using materials and finishes manufactured by any one of the manufacturers previously listed (or approved equal). Materials used throughout shall be the products of one manufacturer only, and shall be first line and top grade materials produced by the manufacturer selected. The mentioning of a specific brand name is done to establish a minimum acceptable standard or quality desired.

See Sect. 01000 regarding Volatile Organic Compound (VOC) restrictions for products.

C. EXECUTION

PREPARATION

All surfaces to be finished shall be power-washed and/or scraped and wiped cleaned free of loose dirt and dust before painting. After the first coat, putty nail holes, cracks, etc. with putty of a color to match that of finish. Bring putty flush to the adjoining surface.

Metal surfaces which are not galvanized or shop-coated shall be washed with mineral spirits to remove dirt and grease. Remove rust or scale by wire brushing or sandpapering clean.

Clean and treat galvanized metal chemically with a compound designed for this purpose, such as "Lithoform", "Stibley", or "Solfo Metallic Coat", in accordance with the paint manufacturer's instructions.

Sand hard glossy-previously painted surface finishes to insure adhesion. Spot prime with primer specified for new surfaces where existing paint or primer has been partially removed by blistering, peeling, rupture, or cracking. Completely remove existing finish if 25 percent or more of the existing finish has failed or can be easily scraped off the surface.

APPLICATION

Application of the first coat shall constitute acceptance of surfaces as fit and proper to receive finish.

Apply all materials under adequate illumination, spread evenly and flow on smoothly without runs or sags. All coats must be thoroughly dry before applying succeeding coats.

Undercoats of paint shall be of the approximate color as the final coat.

For factory-primed and mill-primed surfaces, use the materials specified in every case for such surfaces and use in

accordance with the manufacturer's directions for the first or priming coat.

ADJUSTING AND CLEANING

Clean adjacent and other surfaces which are smeared or splattered as a result of painting and finishing work.

PAINT SCHEDULE

See list of approved manufacturers of paint products earlier in this section. The paint materials listed below are given as a means of establishing the standard for the required paint materials.

INTERIOR WORK

FERROUS METAL AND ALUMINUM ITEMS (I.E., INTERIOR METAL DOORS, SHOP-PRIMED STEEL, ETC.)
1 coat S-W Kem Bond HS Universal Metal Primer, B50 Series (4 mils wet, 1.2 mils dry)
2 coats S-W All Surface Enamel Alkyd Eg-Shel, A11 Series (4 mils wet, 1.6 mils dry per coat)

EXISTING GWB
2 coats S-W ProMar 200 Latex Eg-Shel Enamel, B20W200 (4 mils wet, 1.6 mils dry per coat)

NEW GWB
1 coat S-W PrepRite 200 Latex Wall Primer, B28W200 (4 mils wet, 1.2 mils dry)
2 coats S-W ProMar 200 Latex Eg-Shel Enamel, B20W200 (4 mils wet, 1.6 mils dry per coat)

CONCRETE BLOCK (CMU)
1 coat S-W PrepRite Block Filler B25W25 (75-125 sf/gal.; backroll to fill pores)
2 coats S-W ProMar 200 Latex Eg-Shel Enamel B20W200 (4 mils wet, 1.5 mils dry per coat)

PREVIOUSLY-PAINTED CMU
2 coats S-W ProMar 200 Latex Eg-Shel Enamel B20W200 (4 mils wet, 1.5 mils dry per coat)

MISCELLANEOUS ITEMS

Registers, grilles, heating and water pipes, electrical conduits, outlet boxes, and panelboard fronts exposed in finished rooms shall be painted as specified for Metal Work or as specified or required for the surfaces to be painted. Color shall match color of adjacent wall or ceiling surfaces.

PAINT COLOR SELECTIONS

See Section 09 06 90, Color Schedule.

DIVISION 10 - SPECIALTIES

SECTION 10 44 16
FIREFIGHTING DEVICES

A. GENERAL

REQUIREMENTS OF REGULATORY AGENCIES

UNDERWRITER'S LABEL

Fire extinguishers shall bear the label of Underwriter's Laboratories, Inc., with a rating of 2A:10B:C.

B. PRODUCTS

FIRE EXTINGUISHER CABINETS

Surface-mounted fire extinguisher cabinet FEC-1 shall be Ambassador Model 1013 cabinet manufactured by J.L. Industries with finished sides.

Cabinets, doors, and trim shall be factory-painted white epoxy. Doors shall be "Contemporary V" style with double strength glass. Letters on glass shall be red, mounted on interior surface, and shall read "Fire Extinguisher." Equivalent fire extinguisher cabinets manufactured by Larsen's Manufacturing Company or Potter-Roemer (or approved equal) will also be acceptable.

FIRE EXTINGUISHERS

Fire extinguishers shall be a 10-pound, Cosmic 10E extinguishers with pressure indicating gauges manufactured by J.L. Industries. Equivalent fire extinguishers manufactured by one of the manufacturers listed above for fire extinguisher cabinets (or approved equal) will also be acceptable.

C. EXECUTION

Install fire extinguisher cabinets at all locations where they are shown on the Drawings. Top of cabinet handle shall be 4'-0" above the finish floor.

Install fire extinguishers in fire extinguisher cabinets, where occurring. Where fire extinguishers are shown to be mounted without cabinets, provide brackets for wall-mounting.

SECTION 21 00 00

FIRE SUPPRESSION GENERAL PROVISIONS

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 SECTION INCLUDES

A. This section describes Basic Fire Suppression Requirements required to provide for a complete installation of all fire protection systems for this project. This section shall apply to all other Division 21 specification sections, as well as all work shown on the drawings.

B. It is the intent of the Fire Suppression Division of the Specifications that all mechanical work specified herein be coordinated, as required, with the work of all other Divisions of the Specifications and Drawings so that all installations operate as designed.

C. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation to the satisfaction of the Owner's representative.

D. The Contractor shall note that, in some cases, piping, as shown on the Drawings, provides general location and routing information only. The Contractor shall be responsible for providing interference-free systems with proper clearance to facilities and equipment.

E. Where the work "provide" is used, it shall mean "furnish and install" unless otherwise noted or specified.

F. Pipe, fittings, valves, and connections for sprinkler systems.

1.3 RELATED SECTIONS

A. Section 23 05 00 – Basic HVAC Materials and Methods.

1.4 REFERENCES

A. ASME (BPV IX) – Boiler and Pressure Vessel Code, Section IX – Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 1998.

B. ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers; 1998.

C. ASME B16.3 – Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998.

D. ASME B16.4 – Gray Iron Threaded Fittings; The American Society of Mechanical Engineers; 1999.

E. ASME B16.9 – Factory-made Wrought Steel Buttwelding Fittings; The American Society of Mechanical Engineers; 1993.

F. ASME B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 1984, Reaffirmed 1994 (ANSI B16.18).

G. ASTM A 47/A 47M – Standard Specification for Ferritic Malleable Iron Castings; 1999.

H. ASTM A 53/A 53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2000.

I. ASTM A 795 – Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2000.

J. AWS A5.8 – Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 1992.

K. AWWA C110 – American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm Through 1200 mm), for Water and Other Liquids; American Water Works Association, 1998.

L. AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; 1995 (ANSI/AWWA C111/A21.11).

M. AWWA C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water works Association; 1996 (ANSI/AWWA C151/A21.51).

N. NFPA 13 – Standard for the Installation of Sprinkler Systems; National Fire Protection Association; Current State Adopted Edition.

O. UL (FPED) – Fire Protection Equipment Directory; Underwriters Laboratories Inc.; Current Edition.

P. UL 262 – Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition.

Q. UL 312 – Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition.

1.5 DESCRIPTION OF WORK

A. The work included under this section consists of providing all labor, materials, supervision, and construction procedures necessary for the installation of the complete fire suppression systems required by these specifications and/or shown on the drawing of the contract.

B. The Contract Drawings are shown in part diagrammatic and are intended to convey the scope of work, indicating general arrangement of equipment, piping, etc. The Contractor shall follow the drawings in laying out work and verify clearances for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of outlets or equipment, obtain instructions from the Architect/Engineer before proceeding with the work.

C. Contractor shall coordinate all code required alarm connection points between all fire suppression systems with the fire alarm system. All required tamper and flow switches shall be connected to the building fire alarm systems.

1.6 SUBMITTALS

A. General: Follow the procedures specified in Division 1 Sections “General Conditions” and “Special Conditions.”

B. Shop drawings shall include the minimum following information, as applicable. Additional specific information required is outlined in other Fire Suppression sections:

1. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings. If more than one model number, size, or finish is provided on the manufacturer’s catalog cut sheet, Contractor shall either mark through model/size/finish that does not apply to the project or highlight in some fashion (arrow, circle, highlighter, etc.) all models/sizes/finishes that apply to the project.

2. Installation Drawings: Submit assembly-type shop drawings indicating design area(s), dimensions, required clearances and a symbols legend for all symbols used on drawing. Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, pipe elevations, weights, mounting and support details, and piping connections. Provide hydraulic reference nodes that correspond to hydraulic calculations. Each design area shall have unique reference numbers. Hydraulic nodes that are common to multiple design areas may carry the same reference number in each hydraulic calculation. Provide a Design Area placard by each design area that indicates the design density, calculated flow and pressure, design area name and location within the building, and sprinkler zone if applicable. If more than one zone/riser is provided on the same drawing sheet, provide different line types to differentiate between multiple zone piping.

3. Hydraulic Calculations: Provide design calculations that support the fire suppression layout drawing. Calculations shall start at the design area sprinklers and end at the supply node. Each segment of the calculation shall indicate what fittings and/or valves are included with that segment, in addition to the equivalent pipe length.

4. Wiring Diagrams: Submit manufacturer’s electrical requirements for power supply wiring to electrical equipment. Submit manufacturer’s ladder-type wiring diagrams for interlock and control wiring required for final installation of electrical equipment and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to e field-installed.

5. Project Record Documents: Record actual locations of components and tag numbering.

6. Operation and Maintenance Data: Include installation instructions, spare parts lists, all tests certificates (aboveground and underground piping), warranties, and “AS BUILT” drawings.

1.7 QUALITY ASSURANCE

A. Conform to UL and FM requirements.

B. Valves: Bear UL label or marking. Provide manufacturer’s name and pressure rating marked on valve body.

C. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.8 EXTRA MATERIALS

A. Provide NFPA 13 required quantity of spare stock of sprinklers.

1.9 SUBSTITUTES

A. All proposals shall be based on providing and installing the materials or items of equipment which are hereinafter specified.

B. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing. Associated fire suppression and electrical services, circuit breakers, conduit, motors, bases and equipment spaces are to be increased accordingly, but all recommended manufacturer clearances, etc., are to be maintained within the allotted fire suppression spaces. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

C. Where the terms "or equivalent" is used, the Contractor may substitute alternate equipment, materials, etc. subject to the review by the Architect/Engineer and the Owner's representative during the submittal phase of the project.

D. Where the term "or approved equivalent" is used, the Contractor may not substitute alternate equipment, materials, etc. unless requesting approval at least ten (10) days before the bid date. Notifications of any such approvals by the Architect/Engineer shall only be made in writing by Addendum.

E. Where the term "no equivalent" is used, the Contractor must provide the specified or scheduled equipment, materials, etc.

F. Final determination regarding substitutions shall be by the Architect/Engineer.

1.10 CLOSE-OUT AND OPERATION INSTRUCTIONS.

A. Any system placed in temporary operation for testing or for the convenience of the Contractor during construction shall be properly maintained by the Contactor.

B. All systems shall be protected against freezing, flooding, corrosion or other forms of damage prior to acceptance by the Owner.

C. Material or equipment damaged, shown to be defective or not in accordance with the Specifications shall be repaired or replaced to the satisfaction of the Owner's representative.

D. All tests shall be made after notification to and in the presence of the Owner's representative.

E. Before starting up any system, each piece of equipment comprising any part of the system shall be checked for proper lubrication and any other condition which may cause damage to the equipment or endanger personnel.

F. Conduct a walk-through instruction seminar for the Owner's personnel pertaining to the continued operation and maintenance of the fire suppression equipment and systems. Explain the identification system, maintenance requirements, operational diagrams, pressure control provisions, sequencing requirements, security, safety, efficiently and similar features of the

systems. Walk through must be documented as to those attending and subjects covered. Walk through document(s) shall be signed and dated by the contractor's representative and the owner's representative.

G. At the time of substantial project completion, turn over the prime responsibility for operation of the fire suppression equipment and systems to the Owner's operating personnel. Until the time of final acceptance, provide full time operating personnel, who are completely familiar with the work, to consult with and continue training the Owner's personnel. If any systems are operated prior to substantial completion, the Contractor shall perform all necessary preventative maintenance according to all manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 GENERAL SYSTEM AND PRODUCT REQUIREMENTS

A. Sprinkler Systems: Conform work to NFPA 13 and UFC 3-600-01.

B. Welding Materials and Procedures: Conform to ASME Code.

2.2 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 inches and Over: Carbon Steel, adjustable, clevis.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.

E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

F. Vertical Support: Steel riser clamp.

G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.3 BUTTERFLY VALVES

A. Bronze Body, up to and including 12":

1. Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.

B. Cast or Ductile Iron Body:

1. Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and internal tamper switch rated 10 amp at 115 volt AC.

2.4 CHECK VALVES

A. 4 inches and Over:

1. Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

2.5 DRAIN VALVES

A. Compression Stop:

1. Bronze with hose thread nipple and cap.

B. Ball Valve:

1. Brass with cap and chain, 3/4 inch hose thread.

2.6 EXPANSION COMPENSATION LOOPS

A. Manufacturers:

1. Metraflex, Metraloop Fireloop Model MLUG.

B. Two 90° elbows, braided connectors, 180° return, and factory installed drain/air release plug.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND PROTECTION

A. Deliver and store valves and sprinklers in shipping containers, with labeling in place.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Store and handle material and equipment in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

D. Use proper lifting equipment where size/weight requires handling by such means.

E. Comply with manufacturer's rigging and moving instructions for unloading material and equipment and moving them to final location.

F. Equipment requiring disassembly for access purposes shall be disassembled and reassembled as required for movement into the final location following manufacturer's written instructions.

G. Deliver material and equipment as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

H. Fire Suppression Contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.

3.2 ROUGH-IN

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

B. Refer to equipment specifications in Divisions 2 through 26 for rough-in requirements.

3.3 COORDINATION

A. Sequence, coordinate, and integrate installations of fire suppression materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.

B. Coordinate the fire suppression work with work of the different trades so that:

1. Interferences between fire suppression, mechanical, electrical, architectural, and structural work, including existing services to be avoided.

2. Within the limits indicated on the drawings, the maximum practicable space for operation, maintenance repair, removal and testing of fire suppression and other equipment will be provided.

3. Pipes, ducts, and similar items shall be kept as close as possible to ceiling, walls, and columns, to take up a minimum amount of space. Pipes, ducts, and similar items shall be located so that they will not interfere with the intended use of other equipment.

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

D. Furnish and install, without additional expense to the Owner, all offsets, fittings and similar items necessary in order to accomplish the requirements of coordination.

3.4 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.5 INSTALLATION

A. All dimensions and clearances affecting the installation of work shall be verified in the field in relation to established datum, to building openings and to the work of other trades.

B. The location of all equipment and systems shall be coordinated to preclude interferences with other construction.

C. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the Architect/Engineer and the Owner's representative shall be notified and any changes approved before proceeding with the work.

D. Arrange for chases, slots, and openings in other building components during progress of construction to allow for fire suppression installations.

E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum possible headroom.

F. Coordinate connection of fire suppression systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

G. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

H. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

I. Install piping to conserve building space, to not interfere with use of space and other work.

J. Group piping whenever practical at common elevations.

K. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.

L. Sleeve pipes passing through partitions, walls, and floors.

M. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

N. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

O. Pipe Hangers and Supports:

1. Install in accordance with NFPA 13.

2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

3. Place hangers within 12 inches of each horizontal elbow.

4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

P. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

Q. Do not penetrate building structural members unless indicated.

R. Provide sleeves when penetrating floors. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.

S. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

T. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

U. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.

V. Provide gate or ball valves for shut-off or isolating service.

W. Provide drain valves at main shut-off valves and at all low points of piping.

X. Concrete Bases:

1. Minimum 4" high concrete housekeeping pads shall be provided under floor mounted fire protection equipment. Concrete inertia pads shall be provided for all base-mounted pumps and air compressors.

2. Division 21 Contractors are to notify the General Contractor prior to submitting bid, the number, size and location of all fire suppression equipment bases. The Division 21 Contractor(s) shall be liable for all associated costs to install the fire suppression equipment bases upon failure to notify the General Contractor prior to bid submission.

3. Construct concrete equipment bases a minimum of 4 inches larger in both directions that the supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000 psi, 28-day compressive strength concrete, reinforcement and forms as specified in Division 3 Section "Cast-in-Place Concrete." Coordinate final equipment base size with General Contractor.

Y. Painting:

1. Field paint fire protection equipment and materials in specified areas as noted on the fire suppression plans. Division 21 Contractor(s) shall coordinate the painting of these items with the General Contractor. Provide protective bags over sprinklers and nozzles prior to painting piping and remove prior to placing system into service. Provide materials in these areas that are suitable for accepting paint.

END OF SECTION

SECTION 21 05 00

FIRE PROTECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section specifies automatic sprinkler systems for buildings and structures. Materials and equipment specified in this Section include:

1. Pipe, fittings, valves, and specialties.
2. Sprinklers and accessories.

B. Products furnished and installed shall include sprinkler cabinet with spare sprinklers and sprinkler wrenches.

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

1. Fire Service Piping for fire protection piping from fire service mains to a point 5 feet outside the building.

2. Fire alarm system.

D. Electrical Work: Motors, manual or automatic motor control equipment and protective or signal devices required for the operation specified herein shall be provided under this section in accordance with Electrical Specifications. Any wiring required for the operation specified herein, but not shown on the electrical plans, shall be provided under this section in accordance with Electrical Specifications.

1.2 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Other definitions for fire protection systems are listed in NFPA Standards 13 and 24.

C. Working Plans, as used in this Section, mean those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the authority having jurisdiction.

1.3 SYSTEM DESCRIPTION

A. Fire protection system in areas not subject to freezing shall be a "Wet-Pipe" system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by fire.

B. Sprinkler System Protection Limits: All spaces within areas of new building construction and existing building remodel areas. Include closets, toilet and locker room areas, each landing of each stair, and special applications areas.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Design and obtain approval from authority having jurisdiction for fire protection systems specified.

B. Conduct fire hydrant flow tests, as required, to obtain hydraulic data needed to prepare design for hydraulically calculated systems.

C. Hydraulically design sprinkler systems according to:

1. Sprinkler System Occupancy Hazard Classifications: Sprinkler Contractor shall determine hazard classifications per local and/or any other governing fire codes, latest NFPA codes, and applicable Building Codes. As a minimum, provide hazard classifications as follows:

a. Office and Public Areas: Light hazard.
b. Storage Areas: Ordinary hazard.
c. Equipment Rooms: Ordinary hazard.
d. Service Areas: Ordinary hazard.

2. Minimum Density Requirements for Automatic Sprinkler System Hydraulic Design: Sprinkler Contractor shall provide density requirements per local and/or any other governing fire codes, latest NFPA codes, and applicable Building Codes. Area reductions may be used where listed quick response including quick response extended coverage sprinklers, are used throughout the system or portion of system having same design area in accordance with NFPA 13 guidelines. As a minimum, provide density requirements as follows:

a. Light Hazard Occupancy: 0.10 GPM over 3000 square feet area.
b. Ordinary Hazard, Group 1 Occupancy: 0.15 GPM over 3000 square feet area.
c. Ordinary Hazard, Group 2 Occupancy: 0.20 GPM over 3000 square feet area.

3. Maximum Sprinkler Spacing: Sprinkler Contractor shall provide sprinkler spacing per local and/or any other governing fire codes, latest NFPA codes, applicable Building Codes, and sprinkler UL listing. As a minimum, provide sprinkler spacing as follows:

a. Office Space: 225 square feet/sprinkler.
b. Storage Areas: 130 square feet/sprinkler.
c. Mechanical Equipment Rooms: 130 square feet/sprinkler.
d. Electrical Equipment Rooms: 130 square feet/sprinkler.
e. Other Areas: According to NFPA 13.

D. Components and Installation: Capable of producing piping systems with the following minimum working pressure ratings except where indicated otherwise.

1. Sprinkler Systems: 175 PSIG.

1.5 SUBMITTALS

A. Product Data: Include each type sprinkler, valve, piping specialty, fire protection specialty, and fire department connection specified.

B. Shop Drawings prepared in accordance with NFPA 13 identified as "Working Plans," including hydraulic calculations where applicable, and which have been approved by the authority having jurisdiction.

C. Maintenance Data for each type sprinkler, valve, piping specialty, fire protection specialty, fire department connection, for inclusion in operating and maintenance manual.

D. Welders' Qualification Certificates.

E. Test Reports and Certificates include "Contractor's Material & Test Certificate for Aboveground Piping" and "Contractor's Material & Test Certificate for Underground Piping" as described in NFPA 13.

1.6 QUALITY ASSURANCE

A. System Contractor Certification:

1. Provide proof of fire extinguishing system contractor's certification for the layout, installation, repair, alteration, addition, maintenance or maintenance inspection of the automatic fire extinguishing systems. Certification may be in the form of the following:

a. Current certification by the National Institute for Certification of Engineering Technologies, Level III or above;

b. Current licensure as a professional engineer with competence in fire extinguisher system design.

B. Installer Qualifications: Installation and alterations of fire protection piping, equipment, specialties, and accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified means experienced in such work (experienced shall mean having a minimum of five (5) previous projects similar in size and scope to this project), familiar with all precautions required, and has complied with all the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

C. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS D10.9, "Specifications for Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR-3."

D. Regulatory Requirements: Comply with the requirements of the following codes and standards:

1. UFC 3-600-01 – Unified Facilities Criteria (UFC) Fire Protection Engineering for Facilities.

2. NFPA 13 - Standard for the Installation of Sprinkler Systems.

3. NFPA 26 - Recommended Practice for the Supervision of Valves Controlling Water Supplies for Fire Protection.

4. NFPA 70 - National Electrical Code.

5. NFPA 231 - Standard for General Storage.

6. Local Fire Department Requirements.

7. UL and FM Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled, and Factory Mutual approved for the application anticipated.

8. Local Permits and Inspection Requirements.

9. Local utility requirements.

1.7 SEQUENCING AND SCHEDULING

A. Schedule rough-in installations with installations of other building components.

1.8 EXTRA MATERIALS

A. Valve Wrenches: Furnish to Owner, two (2) valve wrenches for each type of sprinkler head installed.

B. Sprinklers and Cabinets: Furnish spare sprinklers in quantities as outlined in NPFA 13 and shall include each style included in the project or as detailed in NFPA 13. Furnish special wrenches as specified in this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide fire protection system products from one (1) of the following:

1. Specialty Valves, Water Motor Alarms, and Air-Pressure Maintenance Devices:

a. ASCOA Fire Systems, Figgie International Co.
b. Central Sprinkler Corp.
c. Firematic Sprinkler Devices, Inc.
d. Gem Sprinkler Co. Div., Grinnell Corp.
e. Globe Fire Sprinkler Corp.
f. Reliable Automatic Sprinkler Co., Inc.
g. Star Sprinkler Corp.
h. Tyco-Grinnell
i. Viking Corp.

2. Backflow Preventers:

a. Ames Co., Inc.
b. Cla-Val Co.
c. Conbraco Industries, Inc.
d. Febco.
e. Hersey Products, Inc., Grinnell Corp.
f. Watts Regulator Co.
g. Wilkins Regulator Div., Zurn Industries, Inc.

3. Waterflow Indicators and Supervisory Switches:

a. Gamewell Co.
b. Gem Sprinkler Co. Div., Grinnell Corp.
c. Potter Electric Signal Co.
d. Reliable Automatic Sprinkler Co., Inc.
e. System Sensor Div., Pittway Corp.
f. Victaulic Company of America.
g. Watts Regulator Co.

4. Sprinklers:

    a. ASCOA Fire Systems, Figgie International Co.
    b. Central Sprinkler Corp.
    c. Firematic Sprinkler Devices, Inc.
    d. Gem Sprinkler Co. Div., Grinnell Corp.
    e. Globe Fire Sprinkler Corp.
    f. Reliable Automatic Sprinkler Co., Inc.
    g. Star Sprinkler Corp.
    h. Tyco-Grinnell
    i. Firelock; Victaulic Company.
    j. Viking Corp.

5. Flexible Hose Sprinkler Connections:

    a. AquaFlex; Victaulic Company.
    b. FlexHead Industries, Inc.

6. Indicator Valves:

    a. Gem Sprinkler Co. Div., Grinnell Corp.
    b. Grinnell Supply Sales Co., Grinnell Corp.
    c. Kennedy Valve Div., McWane, Inc.
    d. Milwaukee Valve Co., Inc.
    e. Nibco, Inc.
    f. Sprink-Line by Sprink, Inc.
    g. Victaulic Company of America.

7. Fire Protection Service Gate and Check Valves:

    a. Gem Sprinkler Co. Div., Grinnell Corp.
    b. Kennedy Valve Div., McWane, Inc.
    c. Nibco, Inc.
    d. Stockham Valves and Fittings, Inc.
    e. Victaulic Company of America.

8. Grooved Couplings for Steel Piping:

    a. Gruvlok; Anvil Industries.
    b. Tyco-Grinnell
    c. Victaulic Company of America.

9. Grooved Couplings for AWWA Ductile-Iron Piping:

    a. Tyco-Grinnell
    b. Victaulic Company of America.

10. Grooved Couplings for Copper Tubing:

    a. Victaulic Company of America.

11. Press-Seal Fittings for Steel Piping:

    a. Victaulic Company of America.

12. Mechanically Formed Outlet Procedure:

    a. T-Drill Industries, Inc.

2.2 PIPE AND TUBING MATERIALS (SELECTION AS PER LOCAL CODE REQUIREMENTS)

A. Refer to Part 3 Articles "Sprinkler System Piping Applications" and "Standpipe System Piping Applications" for identification of systems where pipe and fitting materials specified below are used.

B. Ductile-Iron Pipe: AWWA C115, ductile-iron barrel with iron-alloy threaded flanges, 250 PSIG minimum working pressure rating, and AWWA C104 cement-mortar lining.

1. Option: Pipe may be AWWA pattern, cut-grooved for grooved-coupling joints.

C. Steel Pipe: ASTM A 53, Schedule 40 in sizes 6-inch and smaller and Schedule 30 in sizes 8-inch and larger, black and galvanized, plain and threaded ends, for welded, threaded, cut-groove, and rolled-groove joints.

D. Steel Pipe: ASTM A 135, Schedule 10 through 5-inch sizes and NFPA 13 specified wall thickness for 6-inch through 10-inch sizes, with plain ends, black and galvanized, for rolled-groove and welded joints.

E. Steel Pipe: ASTM A 795, black and galvanized, for joints listed and for use with fittings for plain-end steel pipe.

1. Type: Standard-weight pipe, Schedules 30 and 40, for cut-groove, rolled-groove, threaded, and welding joints.

2. Type: Lightweight pipe, Schedule 10, for rolled-groove and welding joints.

3. Type: Extra-lightweight pipe, thickness less than Schedule 10, for rolled-groove and welding joints.

F. Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.

2.3 PIPE AND TUBE FITTINGS

A. Cast-Iron Threaded Flanges: ASME B16.1, Class 150, raised ground face, bolt holes spot faced.

B. Ductile-Iron and Gray-Iron Flanged Fittings: AWWA C110, 250 PSIG minimum pressure rating, with AWWA C 104 cement-mortar lining.

C. Cast-Iron Threaded Fittings: ASME B16.4, Class 150, standard pattern, with threads according to ASME B 1.20.1.

D. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threads according to ASME B1.20.1.

E. Grooved-End Fittings for Ductile-Iron Pipe: ASTM A 536 ductile-iron or ASTM A 47 malleable-iron, AWWA pipe-size, designed to accept AWWA C 606 grooved couplings. Include cement lining or Food and Drug Administration (FDA)-approved interior coating.

F. Steel Fittings: ASTM A 234, seamless or welded; ASME B16.9, buttwelding; or ASME B16.11, socket-welding type for welded joints.

G. Steel Flanges and Flanged Fittings: ASME B16.5.

H. Grooved-End Fittings for Steel Pipe: UL-listed and FM-approved, ASTM A 536, Grade 65-45-12 ductile-iron or ASTM A 47 Grade 32510 malleable-iron, with grooves or shoulders designed to accept grooved couplings.

I. Wrought-Copper Fittings: ASME B16.22, streamlined pattern.

J. Cast-Bronze Flanges: ASME B16.24, Class 300, raised ground face, bolt holes spot faced.

K. Grooved-End Fittings for Copper Tube: UL-listed, ASTM B 75, copper tube and ASTM B 584 bronze castings, designed for grooved-end couplings.

L. Mechanically Formed Outlets for Copper Tube: Manufacturer's UL-listed, standard, written procedure for forming "T"-branch outlets.

2.4 JOINING MATERIALS

A. Flanged Joints for Ductile-Iron Pipe and Ductile-Iron or Cast-Iron Fittings: AWWA C 115 ductile-iron or gray-iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.

B. Brazing Filler Metals: AWS A5.8, Classification BcuP-3 or BcuP-4.

C. Couplings for Grooved-End Steel Pipe and Grooved-End Ferrous Fittings: UL 213, AWWA C 606, ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing, with enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design; ASTM A183 carbon-steel bolts and nuts; and locking pin, toggle, or lugs to secure grooved pipe and fittings.

D. Couplings for Grooved-End Ductile-Iron Pipe and Fittings: UL 213, AWWA C 606, ASTM A 536 ductile-iron housing, with enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design, and ASTM A 183 carbon-steel bolts and nuts to secure grooved pipe and fittings.

E. Couplings for Grooved-End Copper Tube and Grooved-End Copper Fittings: UL 213, ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing, with copper-colored enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design, and ASTM A 183 carbon-steel bolts and nuts.

2.5 FIRE PROTECTION SERVICE VALVES

A. General: UL-listed and FM-approved, with 175 PSIG non-shock minimum working pressure rating.

1. Option: Valves for use with grooved piping may be grooved type.

B. Gate Valves, 2-Inch and Smaller: UL 262, cast-bronze, threaded ends, solid wedge, outside screw and yoke, rising stem.

C. Indicating Valves, 2-1/2-Inch and Smaller: Butterfly or ball type, bronze body with threaded ends, and integral indicating device.

1. Indicator: Electrical 115-VAC, prewired, single-circuit, supervisory switch.

D. Gate Valves, 2-1/2-Inch and Larger: UL 262, iron body, bronze mounted, taper wedge, outside screw and yoke, rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.

E. Gate Valves, 2-1/2-Inch and Larger for Use with Indicator Posts: UL 262, iron body, bronze mounted, solid wedge disc, non-rising stem with operating nut and flanged ends.

F. Indicator Posts: UL 789, wall type, cast-iron body, with windows for target plates that indicate valve position, extension rod and coupling, locking device, red enamel finish and supervisory switch.

G. Swing Check Valves, 2-1/2-Inch and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze disc ring and flanged ends.

H. Butterfly Check Valves, 4-Inch and Larger: UL 213, split-clapper style, cast-iron body with rubber seal, bronze alloy discs, stainless-steel spring and hinge pin.

2.6 SPECIALTY VALVES

A. Alarm Check Valves: UL 193, 175 PSIG working pressure, designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, precision retarding chamber, and fill line attachment with strainer.

B. Backflow Preventer Valve: Provide double check backflow preventers. Backflow preventers shall meet the requirements of A.S.S.E. Std. 1015; AWWA Std. C506-78 or USCFCCC Manual for Cross Connection Control. Watts Regulator Company Series 709 or equal.

2.7 SPRINKLERS

A. Automatic Sprinklers: With heat-responsive element conforming to:

1. UL 199, for applications except residential.
2. UL 1626, for residential applications.
3. UL 1767, for early-suppression, fast-response applications.

B. Sprinkler types and categories are as indicated and as required by application. Furnish automatic sprinklers with nominal 1/2-inch orifice for "Ordinary" temperature classification rating except where otherwise indicated and required by application.

C. Sprinkler Finishes:

1. Sprinklers in finished ceiling areas shall be installed within 3-inches of center of ceiling tile and shall be semi-recessed type with chrome finish unless otherwise noted on drawings.

D. Sprinkler Cabinet and Wrenches: Finished steel cabinet suitable for wall mounting with hinged cover and space for quantity of supplied spare sprinklers plus sprinkler wrenches. Provide extra cabinets as necessary to meet the storage requirements of NFPA 13.

2.8 FLEXIBLE HOSE COMMERCIAL SPRINKLER CONNECTIONS

A. Flexible stainless steel hose assemblies and elbow hose assemblies consisting of lengths from 2 feet to 6 feet as required for project conditions. Hangers note required for up to 6 feet of hose assembly. Fully welded non-mechanical or compression mechanical fittings, braided. leak-tested with minimum 1 inch internal corrugated hose diameter fabricated with 304 stainless steel, including end fittings. Complete system shall allow for a total of 270° total bending per flexible drop unless listed for more bends. Flexible assemblies shall be UL listed and FM approved.

1. Outlet Connection: 3/4 inch.
2. Maximum Rated Pressure: 175 PSI.

B. System shall only be authorized for installation in light hazard and ordinary hazard occupancies.

C. Direct attachment flexible hose ceiling bracket with integrated snap-on clip or screw-fastened ends positively attached to the ceiling using tamper-resistant screws and removable attachment hub or open gate clamp with set screw for attaching and adjusting flexible hose.

2.9 ALARM DEVICES

A. Alarm Devices: Types and sizes that will match piping and equipment connections.

B. Water-Motor-Operated Alarms: UL 753, mechanical operation type, 10-inch diameter, cast-aluminum alarm gong, with red enamel factory finish. Include Pelton-wheel-type operator with nylon shaft bearings, and shaft length and sleeve to suit wall thickness and construction; 3/4-inch inlet and 1-inch drain.

C. Electrically Operated Alarm Bells: UL listed exterior wall mounted 6" diameter, electric fire alarm bells, red glossy enamel finish. Provide all conduit and wiring necessary for electrical connection. Size wiring according to manufacturer's recommendations.

D. Waterflow Indicators: UL 346, electrical-supervision type, vane-type waterflow detector, rated to 250 PSIG and designed for horizontal or vertical installation. Include two (2) SPDT (single-pole, double-throw) circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 120-VAC and 0.25 A, 24-VDC. complete with factory-set, field-adjustable retard element to prevent false signals and tamper-proof cover that sends a signal when cover is removed.

E. Pressure Switches: UL 753, waterflow switch with retard, electrical-supervision type, SPDT normally closed contacts, designed to operate on rising pressure and signal water flow.

F. Supervisory Switches: UL 753, for valves, electrical-supervision type, SPDT, normally closed contacts, designed to signal controlled valve in other than full open position.

G. Supervisory Switches: UL 753, for indicator posts, electrical-supervision type, SPDT, normally closed contacts, designed to signal controlled valve in other than full open position.

2.10 PRESSURE GAUGES

A. Pressure Gauges: UL 393, 3-1/2 to 4-1/2 inches diameter dial with dial range of 0-250 PSIG.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which fire protection materials and products are to be installed. Do not proceed until satisfactory conditions have been corrected.

3.2 PIPE APPLICATIONS

A. Black Steel Pipe: Install Schedule 40 for less than 8-inch; Schedule 30 for 8-inch and larger; Class 150, cast-iron threaded fittings, threaded joints.

B. Black Steel Pipe: Install Schedule 40 for less than 8-inch; Schedule 30 for 8-inch and larger; mechanical grooved pipe couplings and fittings; cut-groove type.

C. Black Steel Pipe: Install Schedule 10 for 5-inch and smaller; 0.134-inch wall thickness for 6-inch; and 0.188-inch wall thickness for 8-inch and 10-inch; wrought-steel buttwelding fittings, welded joints.

D. Black Steel Pipe: Install Schedule 10 for 5-inch and smaller; 0.134-inch wall thickness for 6-inch; and 0.188-inch wall thickness for 8-inch and 10-inch mechanical grooved pipe couplings and fittings; roll-groove or mechanical locking type.

3.3 PIPING INSTALLATIONS

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated.

1. Deviations from approved "Working Plans" for sprinkler piping require written approval of the authority having jurisdiction. Written approval shall be on file with the Architect prior to deviating from the approved "Working Plans."

B. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.

C. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Reducing flanges are not permitted.

D. Install unions in pipes 2-inch (50mm) and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.

E. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2-inch and larger connections.

F. Hangers and Supports: Comply with the requirements of NFPA 13 and NFPA 14. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake in accordance with NFPA 13.

G. Make connections between underground and above-ground piping using an approved transition piece strapped or fastened to prevent separation.

H. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls.

I. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.

J. Install pressure gage on the riser or feed main at or near each test connection. Provide gage with a connection not less than 1/4-inch and having a soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and where they will not be subject to freezing.

3.4 PIPE JOINT CONSTRUCTION

A. Welded Joints: AWS D10.9, Level AR-3.

B. Threaded Joints: conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:

1. Note the 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.

2. Align threads at point of assembly.

3. Apply appropriate tape or thread compound to the external pipe threads.

4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.

5. Damaged Threads: Do not use pipe with threads which are stripped, chipped, corroded, or otherwise damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

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

D. Mechanical Grooved Joints: cut or roll grooves on pipe ends dimensionally compatible with the couplings.

E. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.

3.5 VALVE INSTALLATIONS

A. General: Install fire protection specialty valves, fittings, and specialties in accordance with the manufacturer's written instructions, NFPA 13, and the authority having jurisdiction.

B. Gate Valves: Install supervised-open gate valves so located to control all sources of water supply except fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve.

C. Install check valves in each water supply connection.

D. Alarm Check Valves: Install valves in the vertical position, in proper direction of flow including the bypass check valve and retard chamber drain line connection. Install valve trim in accordance with the valve manufacturer's appropriate trim diagram. Test valve for proper operation.

E. Backflow Preventer Valve: Install in accordance with manufacturer's instructions and local code requirements, at each fire service entrance.

3.6 SPRINKLER INSTALLATIONS

A. Use proper tools to prevent damage during installations.

3.7 FLEXIBLE HOSE COMMERCIAL SPRINKLER INSTALLATIONS

A. Limit stainless steel hose assemblies and elbow hose assemblies to no greater than 270° total bending per each drop unless drop assembly is listed for more turns. For FM-approved systems maximum bend radius shall not exceed 7 times braided hose diameter.

B. Manufacturer shall provide written procedures for proper installation of flexible hose sprinkler systems.

3.8 FIRE SPRINKLER SYSTEM COORDINATION AND WARRANTY

A. The General Contractor and Sprinkler Subcontractor shall meet with the Architect/Engineer to coordinate routing of all piping and sprinkler placement in exposed areas prior to submittal of Shop Drawings to ascertain the aesthetic requirements in such areas.

B. The General Contractor shall take full responsibility for locating all fire sprinkler piping and sprinklers within the building at locations not subject to freezing conditions. For areas of the building where that is not deemed possible, a "dry" system shall be substituted. The Contractor, in locating such piping and sprinkler, shall take into account the possibility that the interior space temperature may be reduced to approximately 60°F through the Owner's off-hours temperature control setback.

C. In areas where concealment of the sprinkler is required, if the General Contractor and/or Sprinkler Contractor determine that additional chases, bulkheads and other architectural modifications are required in order to conceal the piping while complying with the above freeze protection requirements, they shall coordinate such concerns with the Architect/Engineer prior to submittal of Shop Drawings.

D. All entry vestibules and other minimally conditioned spaces, where system piping, sprinklers and/or drop nipples are subject to freezing, dry pendant sprinklers shall be used.

E. The General Contractor shall coordinate installation of the fire sprinkler system with the insulation characteristics of the building, and warrant the fire sprinkler system against freezing for a period of two (2) years from date of Substantial Completion. Such warranty shall cover the cost of repair including damaged building materials. Such warranty shall not cover freezing in the event of a loss of heat due to malfunction or shut down of mechanical heating system beyond normal set backs previously stated.

3.9 FIELD QUALITY CONTROL

A. Flush, test, and inspect both underground fire main and aboveground sprinkler piping systems in accordance with NFPA 13 and NFPA 24. Provide certification of both underground and above ground flushing.

B. Replace piping system components which do not pass the test procedures specified, and retest repaired portion of the system.

C. Provide a plastic pouch attached to system riser large enough to house the following: copy of underground flushing certification, aboveground flushing certification, copy of "As-Built" drawings, a copy of 2-hour pressure test and system certification and a copy of NFPA 25.

D. Provide copies of all testing and certification documents/reports and a copy of "As-Built" drawings in the project O & M Manual.

END OF SECTION

SECTION 21 11 00

FIRE SUPPRESSION WATER SERVICE SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of fire suppression water service systems work is indicated on drawings and schedules and by requirements of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire suppression water service system products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with fire suppression water service work similar to that required for project.

C. Codes and Standards:

1. NFPA Compliance: Install fire suppression water service systems in accordance with NFPA 24 "Standard for the Installation of Private Fire Service Mains and Their Appurtenances".

2. Local Fire Department/Marshal Regulations: Comply with governing regulations and similar matching of connections.

3. UL Compliance: Provide fire hydrants that comply with UL 246 "Hydrants for Fire-Protection Service" and are listed by UL.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for fire suppression water service system materials and products.

B. Shop Drawings: Submit shop drawings for fire suppression water service systems, showing piping materials, size, locations and elevations. Include details of underground structures, connections, thrust blocks, and anchors. Show interface and spatial relationship between piping and proximate structures.

C. Record Drawings: At project closeout, submit record drawings of installed fire suppression water service system piping and products.

D. Maintenance Data: Submit maintenance data and parts lists for fire suppression water service system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual.

PART 2 - PRODUCTS

2.1 IDENTIFICATION

A. Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; but not less than 6-inch wide x 4 MILS thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW".

B. Manufacturer: Subject to compliance with requirements, provide identification markers of one (1) of the following:

1. Allen Systems Inc.
2. Seton Identification Products.

2.2 PIPES AND PIPE FITTINGS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with NFPA 24 where applicable. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire suppression water service piping systems. Where more than one (1) type of materials or products is indicated, selection is Installer's option.

B. Piping: Provide pipes of one (1) of the following materials, of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

C. Ductile-Iron Pipe: AWWA C151, with cement mortar lining complying with AWWA C104; Class 51 unless otherwise indicated.

1. Fittings: Ductile-iron complying with AWWA C110, cement lined, with rubber gaskets conforming to AWWA C111.

D. Polyvinyl Chloride Pipe: AWWA C900, Class 150; bell and spigot with rubber sealing ring.

1. Fittings: Ductile-iron complying with AWWA C110, cement lined, with rubber gaskets conforming to AWWA C111.

E. Steel Pipe: AWWA C200 for 6-inch and larger; with cement-mortar lining conforming to AWWA C205; and coal-tar enamel protective coating, AWWA C203.

1. Fittings: Steel water pipe fittings, AWWA C208; welded joints, AWWA C206.

2.3 PIPING SPECIALTIES

A. Pipe Line Strainers: Provide as indicated, pipe line strainers, UL-listed, 175 PSI working pressure, Y-type or basket type, with ends to suit piping connections.

B. Manufacturer: Subject to compliance with requirements, provide pipe line strainers of one (1) of the following:

1. "Automatic" Sprinkler Corp. of America; Div. A-T-O Inc.
2. Cleveland Gear Co.; Sub. of Vesper Corp.
3. Grinnell Fire Protection Systems Co., Inc.
4. Hersey Products Inc.; Hersey Div.
5. Mueller Steam Specialty; Div. of Core Industries Inc.
6. Neptune Water Meter Co.
7. Rockwell International Corp.; Municipal & Utility Div.
8. Rockwood Systems Corp.
9. Zurn Industries Inc.; Fluid Handling Div.

2.4 VALVES

A. Gate Valves: Provide gate valves, UL-listed, 175 PSI working pressure for 12-inch and smaller, 150 PSI for sizes larger than 12-inch. Provide threaded, flanged, hub, or other end configurations to suit size of valve and piping connection. Provide inside screw type for use with indicator post, iron body bronze mounted, non-rising stem, solid wedge disc.

1. Manufacturer: Subject to compliance with requirements, provide gate valves of one (1) of the following:

a. American Valve Mfg. Corp.
b. American-Darling Valve; Div. of American Cast Iron Pipe Co., Inc.
c. Clow Corp.; Valve Div.
d. Fairbanks Co.
e. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
f. Stockham Valves & Fittings Inc.
g. United Brass Works Inc.
h. United States Pipe and Foundry Co.
i. Waterous Co.

B. Indicator Posts: Provide indicator posts, UL-listed, designed for use with the underground gate valves to provide aboveground means for operating valves and indicating position of valves. Provide telescopic barrel type with indicating target, extension rod and coupling, operating wrench, locking device, red enamel finish, and supervisory switch intended for use with gate valves 4-inch through 14-inch.

1. Manufacturer: Subject to compliance with requirements, provide indicator posts of one (1) of the following:

a. American-Darling Valve; Div. of American Cast Iron Pipe Co.
b. Clow Corp.; Valve Div.
c. Eddy-Iowa; Div. Clow Corp.
d. Fairbanks Co.
e. Grinnell Fire Protection Systems Co., Inc.
f. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
g. Mueller Co.
h. Standard Fire Protection Co.
i. Stockham Valves & Fittings Inc.
j. United States Pipe and Foundry Co.
k. Waterous Co.

C. Butterfly Valves: Provide butterfly valves, UL-listed, 175 PSI working pressure for 2-inch through 12-inch, 150 PSI for sizes larger than 12-inch. Provide gear actuator and position indicator.

1. Manufacturer: Subject to compliance with requirements, provide butterfly valves of one (1) of the following:

a. Demco; Div. of Cooper Industries Inc.
b. ITT Grinnell; Div. of ITT Industries of Canada Ltd.
c. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
d. Keystone Valve; Div. of Keystone International Inc.
e. Nibco Inc.
f. Powell (Wm.) Co.
g. Pratt (Henry) Co.
h. Tomoe Valve Co. Ltd.

D. Check Valves: Provide check valves as indicated, UL-listed, 175 PSI working pressure for 2-inch through 12-inch, 150 PSI for sizes larger than 12-inch. Provide swing type, iron body bronze mounted with metal-to-metal or rubber-faced checks. Provide threaded, flanged, or hub-end, to suit size and piping connections.

1. Manufacturer: Subject to compliance with requirements, provide check valves of one (1) of the following:

a. American-Darling Valve; Div. of American Cast Iron Pipe Co.
b. Clow Corp.; Valve Div.
c. Fairbanks Co.
d. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
e. Mueller Co.
f. Nibco Inc.
g. Stockham Valves & Fittings Inc.
h. Walworth Co.
i. Waterous Co.

E. Detector Check Valves: Provide detector check valves as indicated, UL-listed, 175 PSI working pressure. Provide iron or brass bodied with weighted clapper and provisions for connection of by-pass meter around check.

1. Manufacturer: Subject to compliance with requirements, provide detector check valves of one (1) of the following:

a. Ames Co. Inc.
b. Central Sprinkler Corp.
c. Firematic Sprinkler Devices Inc.
d. Globe Fire Equipment Co.
e. Hersey Products Inc.
f. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
g. Mueller Co.
h. Reliable Automatic Sprinkler Co., Inc.
i. Viking Corp.

2.5 ACCESSORIES

A. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.

1. Clamps, Straps, and Washers: Steel, ASTM A 506.
2. Rods: Steel, ASTM A 575.
3. Rod Couplings: Malleable-iron, ASTM A 197.
4. Bolts: Steel, ASTM A 307.
5. Cast-Iron Washers: Gray-iron, ASTM A 126.
6. Thrust Blocks: Concrete, 2,500 PSI.

PART 3 - EXECUTION

3.1 INSTALLATION OF IDENTIFICATION

A. General: During back-filling/top-soiling of underground fire suppression water service piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6-inch to 8-inch below finished grade.

3.2 INSTALLATION OF PIPE AND PIPE FITTINGS

A. Ductile-Iron Pipe: Install in accordance with AWWA C600 "Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances".

B. Polyvinyl Chloride Pipe: Install in accordance with manufacturer's installation instructions.

C. Steel Pipe: Install in accordance with AWWA M11 "Steel Pipe - Design and Installation".

D. Depth of Cover: Provide minimum depth of cover over underground piping in accordance with NFPA 24, Figure A-8-11 "Recommended Depth of Cover Above Top of Underground Yard Mains".

3.3 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Line Strainers: Install as indicated, with valved blowoff piped to drain.

3.4 INSTALLATION OF METERS

A. General: Install as indicated with shutoff valve on either side of meter and valved bypass full line size.

3.5 INSTALLATION OF VALVES

A. General: Install valves as indicated. Provide post indicator for control valves.

B. Control Valves: Install post indicator valve at each connection into building, locate 40-feet from building outside wall, or as indicated.

C. Shutoff Valves: Install shutoff valve ahead of each hydrant.

3.6 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline with water 24 hours prior to testing, and apply test pressure to stabilize system.

B. Hydrostatic Tests: Test at not less than 200 PSI for two (2) hours or at 50 PSI above maximum static pressure if it is greater than 150 PSI.

1. Test fails if leakage exceeds 2 quarts per hour per 100 gaskets or joints irrespective of pipe diameter.

2. Increase pressure in 50 PSI increments and inspect each joint between increments. Hold at test pressure for one (1) hour, decrease to 0 PSI. Slowly increase again to test pressure and hold for one (1) more hour.

C. Operating Tests: Open and close all valves and hydrants under system water pressure. Check dry barrel hydrants for proper drainage.

1. For systems with fire pumps, run pumps during operating tests.

3.7 ADJUSTING AND CLEANING

A. Flushing: Flush underground mains and lead-in connections to sprinkler risers before connection is made to sprinklers, standpipes, or other fire protection system piping.

1. Flush at flow rate not less than that indicated in NFPA 24, or at hydraulically calculated water demand rate of the system, whichever is greater.

END OF SECTION

SECTION 22 05 00

BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes the following basic mechanical materials and methods.

1. Piping materials and installation instructions common to most piping systems.

a. Valves:

(1) Gate
(2) Ball
(3) Plug
(4) Globe
(5) Butterfly
(6) Check

b. Valve Tags and Schedule Frames.

c. Piping Specialties:

(1) Pipe escutcheons
(2) Pipeline strainers
(3) Pipe sleeves
(4) Dielectric unions

d. Meters and gauges:

(1) Glass thermometers
(2) Pressure gauges

e. Supports and anchors:

(1) Horizontal-piping hangers and supports
(2) Saddles and shields

2. Mechanical identification.

3. Access panels.

4. Nonshrink grout for equipment installations.

5. Joint sealers for sealing around mechanical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.

6. Installation requirements common to piping and equipment specification Sections.

7. Concrete equipment base construction requirements.

8. Mechanical demolition.

9. Cutting and patching.

10. Piping tests.

B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.

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

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

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

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

F. 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.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract.

B. Product data for following piping specialties:

1. Valves.
2. Mechanical sleeve seals.
3. Thermometers.
4. Pressure gauges.
5. Identification materials and devices.
6. Vibration Isolators.
7. Access panels.

C. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

D. Coordination drawings for access panel and door locations.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code Steel."

B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

C. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions."

D. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves."

E. FCI Compliance: Test and rate Y-type strainers in accordance with FCI 73-I "Pressure Rating Standard for Y-type strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than Y-type".

F. UL and FM Compliance: Provide meters, gauges, and supports which are UL-listed and FM approved.

G. MSS Standard Compliance: Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

H. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

I. Equipment Selection: Equipment of greater or larger power, 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. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

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

D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

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

C. Coordinate the 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 prior to closing in the building.

E. Coordinate connection of electrical services.

F. 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.

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

H. Perform demolition in phases as indicated.

1.8 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:

1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

2. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.

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

2.2 JOINING MATERIALS

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

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3mm) maximum thickness, except where 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. ASME B16.20 for grooved, ring-joint, steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.

C. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.

D. Solder Filler Metal: ASTM B 32.

1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95%) and silver (approximately 5%), having 0.10% lead content.

2. Alloy Sn50: Tin (50%) and lead (50%) (for use on nonpotable water systems only).

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

F. Solvent Cements: Manufacturer's standard solvents complying with the following:

1. Poly(Vinyl Chloride) (PVC): ASTM D 2564.

G. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.

H. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.

1. Sleeve: ASTM A126, Class B, gray iron.
2. Followers: ASTM A 47 (ASTM A 47M), Grade 32510 or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

A. Pipe Escutcheons:

1. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

3. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

B. Low Pressure Pipeline Strainers:

1. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 PSI working pressure, with Type 304 stainless steel screens, with 3/64-inch perforations at 233 per square inch.

2. Threaded Ends, 2-inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.

3. Threaded Ends, 2-1/2-inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

4. Flanged Ends, 2-1/2-inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

5. Butt Welded Ends, 2-1/2-inches and Larger: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.

6. Grooved Ends, 2-1/2-inches and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

C. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.

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

3. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150 or 300 PSIG (1035 kPa or 2070 kPa) minimum pressure to suit system pressures.

4. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

   a. Provide separate companion flanges and steel bolts and nuts for 150 or 300 PSIG (1035 kPa or 2070 kPa) minimum working pressure to suit system pressures.

5. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300 PSIG (2070 kPa) minimum working pressure at 225°F (107°C) temperature.

6. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300 PSIG (2070 kPa) working pressure at 225°F (107°C) temperature.

D. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.

E. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet-Metal: 24-gauge (0.70mm) or heavier galvanized sheet metal, 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, having plain ends and integral water stop, except where other features are specified.

2.4 VALVES

A. General: Provide factory-fabricated valves recommended by Manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with Installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Gate Valves: Comply with the following requirements:

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

2. Gate Valves - 2-Inches and Smaller: MSS SP-80; Class 150, body and union bonnet as ASTM B 62 cast bronze, threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel.

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

C. Ball Valves: Comply with the following requirements:

1. Ball valves - 1-inch and Smaller: Rated for 150 PSI SWP pressure, 600 PSI non-shock WOG pressure; 2-piece construction, bronze body conforming to ASTM B 584 or B61, full port, 316 stainless steel ball, reinforced "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide extended solder ends for domestic hot and cold water service;. Provide 2-inch extended handles of non-thermal conductive material. Valve pressure ratings shall be cast into the body of the valve.

2. Ball Valves - 1-1/4-Inches to 2-Inches: Rated for 150 PSI SWP pressure, 600 PSI non-shock WOG pressure; 2-piece construction, bronze body conforming to ASTM B 584 or B61, full port, 316 stainless steel ball, reinforced and replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide extended solder ends for domestic hot and cold water service. Provide 2-inch extended handles of non-thermal conductive material. Valve pressure ratings shall be cast into the body of the valve.

D. Plug Valves: Comply with the following requirements:

1. Plug Valves - 2-Inches and Smaller: 150 PSI WOG, bronze body, straightaway pattern, square head, threaded ends.

2. Plug Valves - 2-1/2-Inches and Larger: MSS SP-78; 175 PSI WOG, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.

E. Globe Valves: Comply with the following requirements:

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

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

F. Butterfly Valves: Comply with the following requirements:

1. Butterfly Valves - 2-1/2-Inches and Larger: MSS SP-67; 200 non-shock PSI, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with aluminum bronze disc, 400 Series stainless steel stem, and EPDM O-ring stem seals. Sizes 2-1/2-inch through 6-inches shall have 10-position lever operators with locks, and sizes 8-inch through 24-inch shall have gear operators with position indicator. Provide wafer type valve. Drill and tap valves on dead-end service or requiring additional body strength. Valve shall be capable of bi-directional dead end service with downstream flange removed at full-rated pressure.

G. Check Valves: Comply with the following requirements:

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

2. Swing Check Valves - 2-1/2-Inches and Larger: MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

3. Wafer Check Valves: Class 250, cast iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Valve shall be designed to open and close at approximately one foot differential pressure.

2.5 VALVE TAGS

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

1. Provide 1-1/2-inch diameter tags, except as otherwise indicated.
2. Fill tag engraving with black enamel.

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

2.6 VALVE SCHEDULES

A. General: Provide a valve schedule for each piping system on standard size bond paper. Schedule shall include valve identification number, piping system, size and location of valve, normal operating position and additional remarks as required. Identify valve use for emergency shutoff or similar special use.

2.7 VALVE SCHEDULE FRAMES

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

2.8 METERS AND GAUGES

A. Thermometers:

1. General: Provide thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

2. Case: Die cast aluminum finished in baked epoxy enamel or hard powder coat finish, glass or acrylic front, 9-inches long.

3. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.

4. Tube and Capillary: Blue organic-liquid filled, magnifying lens, ±1 scale division accuracy, shock mounted.

5. Scale: Satin faced, non-reflective white aluminum, permanently etched black markings.

6. Stem: Copper-plated steel, brass or die-cast aluminum, for separable socket, length to suit installation.

7. Thermometer Wells: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2-inch extension for insulated piping. Provide cap fastened to well when used in a non-permanent thermometer location.

8. Thermometer wells shall be installed at each thermometer and at each point where a temperature sensing device is required by the control specifications.

9. Range: Conform to the following:

   a. Hot Water: 30°F to 240°F with 2°F scale divisions.

10. Acceptable Manufacturers:

    a. Marsh Gauges.
    b. Moeller Instruments.
    c. Miljoco Corporation.
    d. Weiss Instruments.

B. Pressure Gauges:

1. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

2. Type: General use, ±1% accuracy, ANSI B 40.1 Grade 1A, phosphor bronze bourdon type, bottom connection.

3. Case: Stainless steel, glass or acrylic lens, 4-1/2-inch diameter.

4. Connector: Brass, lower mount with 1/4-inch male NPT.

5. Scale: White coated aluminum, with permanently etched black markings.

6. Accessories:

   a. Provide protective coil siphon when used for steam service.
   b. Provide each gauge with a shut-off needle valve.
   c. Provide pressure snubber where spikes may be present.

7. Range: Conform to the following:

   a. Water: 0-100 PSI.

8. Acceptable Manufacturers:

   a. Marsh Gauges.
   b. Moeller Instruments.
   c. Miljoco Corporation.
   d. Weiss Instruments.

2.9 SUPPORTS AND ANCHORS

A. Horizontal-Piping Hangers and Supports:

1. General: Except as otherwise indicated, provide factory- fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one (1) of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one (1) type by one (1) manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

2. Adjustable Steel Clevis Hangers: MSS Type 1.

3. Yoke Type Pipe Clamps: MSS Type 2.

4. Steel Double Bolt Pipe Clamps: MSS Type 3.

5. Steel Pipe Clamps: MSS Type 4.

6. Pipe Hangers: MSS Type 5.

7. Trapeze type with horizontal angle iron.

B. Saddles and Shields:

1. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

2. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

3. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

4. Thermal Hanger Shields: Constructed of 360 degree insert of high density, 100 PSI, water-proofed calcium silicate, encased in 360 degree sheet metal shield. Provide assembly of same thickness as adjoining insulation.

2.10 MECHANICAL IDENTIFICATION

A. Equipment Markers:

1. General: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive or fasteners to mount on equipment.

NOTE: Coordinate if Owner has a required equipment bar code system that also needs to be specified here.

2. Terminology: Match drawing schedules as closely as possible unless directed otherwise by Owner.

3. Data Required:

a. Equipment Description, i.e. Domestic Water Heater.
b. Schedule Mark, i.e. DWH-1.

4. Marker Size: 2-1/2- by 4-inches for main control valves; 4-1/2- by 6-inches for equipment.

B. Plastic Pipe Markers:

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

2. Small Pipes: For external diameters less than 6-inches (including insulation if any), provide full-band pipe markers, extending 360° around pipe at each location, fastened by the following method:

a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2-inches.

3. Large Pipes: For external diameters of 6-inch and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three (3) times letter height (and of required length), fastened by one (1) of the following methods:

a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2-inches wide, full circle at both ends of pipe marker, tape lapped 3 inches.

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

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

C. Plastic Tape:

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

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

3. Color: Comply with ANSI A13.1, or as scheduled below:

ITEM	BAND COLOR
Domestic Cold Water	Green
Domestic Hot Water	Yellow
Natural Gas	Yellow
Insulated Drains and Downspouts	Green

2.11 ACCESS PANELS

A. All panels shall be MILCOR, Style "M" for masonry, Style A for acoustical tile, and Style K for plaster; except that Fire Rated UL 1-1/2 hour and "B" label access panels shall be furnished in fire-rated walls and ceilings as indicated on the Drawings.

B. Access doors shall be 12-inch x 12-inch minimum size for valves and water hammer arrestors and shall be 24-inch x 36-inch for access to equipment and filters.

2.12 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000 PSI (34.50 MPa), 28 day compressive strength.

3. Packaging: Premixed and factory-packaged.

2.13 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One-part, non-acid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.

2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and non-porous joint substrates; formulated with fungicide; intended for sealing interior joints with non-porous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.

3. Products: Subject to compliance with requirements, provide the following:

a. One-Part, Non-acid-Curing, Silicone Sealant:

(1) "Dow Corning 790," Dow Corning Corp. (or Equal)

b. One-Part, Mildew-Resistant, Silicone Sealant:

(1) "Dow Corning 786," Dow Corning Corp. (or Equal)

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5%.

1. Products: Subject to compliance with requirements, provide the following:

a. "Chem-Calk 600," Bostic Construction Products Div. (or Equal)

E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistant ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide the following:

a. "Dow Corning Fire Stop Foam," Dow Corning Corp. (or Equal)

PART 3 - EXECUTION

3.1 PIPING SYSTEMS-COMMON REQUIREMENTS

A. General: Install piping as described below, except where system Sections specify otherwise.

B. General Locations and Arrangements: Drawings (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, except where deviations to layout are approved on coordination drawings.

C. Install piping at indicated slope.

D. Install components having pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

H. 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.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

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

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

L. Install couplings according to manufacturer's printed instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.

2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.

3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.

4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.

5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.

N. Sleeves are not required for core drilled holes.

O. Permanent sleeves are not required for holes formed by PE plastic (removable) sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2-inches (50mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.

2. Build sleeves into new walls and slabs as work progresses.

3. Install large enough sleeves to provide 1/4-inch (6mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than 6-inches.

   b. Steel Sheet-Metal Sleeves: For pipes 6-inches and larger that penetrate gypsum-board partitions.

   c. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2-inches (50mm) above finished floor level.

4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.

Q. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch (25mm) annular clear space between pipe and sleeve for installation of mechanical seals.

1. Install steel pipe for sleeves smaller than 6-inch.
2. Install cast-iron wall pipes for sleeves 6-inch and larger.
3. Assemble and install mechanical seals according to manufacturer's printed instructions.

R. Below Grade, Exterior Wall, Pipe Penetrations: Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch (25mm) annular clear space between pipe and sleeve for installation of mechanical seals.

S. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material.

T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system 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 "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."

4. 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 inside diameter. Join pipe fittings and valves as follows:

   a. Note the 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 (except where 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 having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

5. 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.

6. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:

a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.

b. Poly(Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.

U. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

1. Install unions in piping 2-inch (50mm) and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch (50mm) or smaller threaded pipe connection.

2. Install flanges in piping 2-1/2-inches (65mm) and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

3. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems (Water): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

5. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.

6. Install isolation valves upstream of all dielectric unions and flanges.

3.2 EQUIPMENT INSTALLATION-COMMON REQUIREMENTS

A. Install equipment to provide the maximum possible headroom where 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 the Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 VALVE SELECTION

A. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size 2-Inch and Smaller: Solder ends.

2. Steel Pipe Sizes 2-Inch and Smaller: threaded.

3. Steel Pipe Sizes 2-1/2-Inch and Larger: grooved-end or flanged.

3.4 VALVE INSTALLATIONS

A. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.

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

C. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices.

D. Install 3-valve bypass around each pressure reducing valve using throttling type valves.

E. Install valves in horizontal piping with stem at or above the center of the pipe, and to allow full stem movement.

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

1. Swing Check Valves: Install in horizontal position with hinge pin level.
2. Wafer Check Valves: Install between two (2) flanges in horizontal or vertical position.
3. Lift Check Valve: Install in piping line with stem upright and plumb.

G. Valve Schedule:

1. Sectional Valves:

a. 2-inch and Smaller: Ball valves.
b. 2-1/2-inch and Larger: Gate or butterfly valves.

2. Shut-off Valves:

a. 2-inch and Smaller: Ball valves.
b. 2-1/2-inch and Larger: Gate or butterfly valves.

3. Throttling Valves:

a. 2-inch and Smaller: Ball or globe valves.

b. 2-inch and Larger: Globe or butterfly valves.

H. Valve Locations:

1. Plumbing Piping:

a. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves two (2) or more plumbing fixtures or equipment connections, and elsewhere as indicated.

b. Shut-off Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.

c. Throttling Valves: As required on plans.

2. Valve Tags:

a. Provide valve tags for all valves and list on Valve Schedule.

b. Install tags on valves in piping systems, except check valves, valves within factory-fabricated equipment units; plumbing fixture supply stops; and HVAC terminal devices.

3.5 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

		VALVES 2-INCHES AND SMALLER		
SERVICE	GATE	GLOBE	BALL	CHECK
Domestic Hot & Cold Water	125	125	150	125

		VALVES 2-1/2-INCHES AND LARGER		
SERVICE	GATE	GLOBE	BUTTERFLY	CHECK
Domestic Hot & Cold Water	125	125	200	125

3.6 PIPING SPECIALTIES INSTALLATION

A. Y-Type Strainers: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shut-off valve in strainer blow-down connection, full size of connection, except for strainers 2-inch and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shut-off valve to plumbing drain, full size of blow-down connection.

1. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment:

a. Pumps.
b. Temperature control valves.
c. Pressure reducing valves.
d. Temperature or pressure regulating valves.

B. Dielectric Fittings: Install at each piping joint between ferrous and nonferrous piping. Comply with manufacturer's installation instructions.

1. Install isolation valves upstream of all dielectric unions.

3.7 METERS AND GAUGES INSTALLATION

A. Glass Thermometers:

1. General: Install glass thermometers in vertical upright position, and tilted so as to be easily read by observer standing on floor.

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

a. At inlet and outlet of each domestic water heater.

B. Pressure Gauges:

1. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.

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

a. Across suction and discharge of each hydronic pump.

b. At discharge of each pressure reducing valve.

c. At domestic water service entrance.

3.8 SUPPORTS AND ANCHORS INSTALLATION

A. Hangers and Supports:

1. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping. Piping shall not be supported from bottom cord of bar joist or from metal roof deck, unless approved by Structural Engineer. Piping may be supported at panel points of bar joists.

2. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

3. Powder-actuated fasteners shall be approved only for installation where load will be applied perpendicular to the fasteners. Powder-actuated fasteners shall not be used where load will be applied to axially to the fasteners.

4. Support fire-water piping independently of other piping.

5. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

B. Saddles and Shields:

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

   a. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8-inch and over, install wood insulation saddles.

   b. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.9 MECHANICAL IDENTIFICATION INSTALLATION

A. Install equipment markers with permanent adhesive or appropriate fasteners on or near each major item of mechanical equipment

   1. Locate markers where accessible and visible.

   2. Include markers for the following categories of equipment:

      a. Main control and operating valves.

      b. Pumps, water heaters, tanks, pressure vessels, humidifiers, water-treatment systems, and similar equipment.

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

   1. Near each valve and control device.

   2. Near each branch, excluding short take-offs for fixtures; mark each pipe at branch, where there could be question of flow pattern.

   3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

   4. At access doors, manholes and similar access points which permit view of concealed piping.

   5. Near major equipment items and other points of origination and termination.

   6. Spaced intermediately at maximum spacing of 50-feet along each piping run, except reduce spacing to 25-feet in congested areas of piping and equipment.

   7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.10 ACCESS PANEL INSTALLATION

A. Mechanical Contractor shall locate and furnish for installation by General Contractor, all access panels as required for access to valves and water hammer arresters, dampers, and the proper servicing of equipment and piping installed under this Contract.

3.11 CONCRETE BASES

A. Construct concrete equipment bases of dimensions indicated, but not less than 4-inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000 PSI, 28 day compressive strength concrete and reinforcement.

3.12 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."

3.13 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.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.14 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned plumbing materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing plumbing materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage by Owner.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. Plumbing Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete piping, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.

a. Piping embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings. Drain and cap piping allowed to remain.

3.15 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.16 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 printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

3.17 PIPING TEST

A. No piping work, fixtures, or equipment shall be concealed or covered until they have been observed by the Engineer's representative, who shall be notified by the Contractor when the work is ready for inspection. All work shall be completely installed, tested as required by this Section and the State Ordinances and State Safety Orders, and shall be leak-tight before inspection is requested. All tests shall be repeated upon request to the satisfaction of those making the inspection.

B. All domestic water piping shall be flushed, tested at 100 PSI and shall be left under pressure of supply main or a minimum of 40 PSI for the balance of the construction period.

C. Piping tests shall be made with the test medium and under test pressures listed in the following table. Use a calibrated Bristol Pressure Recorder, or equal, on all tests. Engineer's representative shall install and remove each chart. Recorder range shall be 0-300 pounds or required range for specific test.

PIPING TESTS

Type of Piping	Test Pressure	Test Medium	Test Period
Soil, Waste, Vent, Rain Water Leaders and Storm Drainage Piping Within Building	Minimum of 10 foot head on each joint with no loss in head	Water	One Hour
Domestic Water 1. Pressure Regulated to and including 80 PSI	150 PSIG	Water	Two Hours
2. Non-regulated above 80 PSI	Twice normal static pressure at the service point	Water	Two Hours
Fuel Gas, and Fuel Oil Return	50 PSIG	Air	One Hour

D. Test pressure in lbs. per square inch, or inches of vacuum, gauge, are given as an initial pressure to be applied to lines being tested, together with test medium.

E. Final pressures at the end of test period shall be no more or less than that caused by expansion or contraction of the test medium due to temperature changes.

F. Check of systems during application of test pressures should include visual check for water medium leakage, soap bubble or similar for air and nitrogen medium, and halide torch for refrigerant medium after charging.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.1 GENERAL

A. Plumbing insulation required by this section is indicated on drawings, and by requirements of this section.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation.

B. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each plumbing system requiring insulation.

1.3 QUALITY ASSURANCE

A. Furnish insulation and materials bearing the manufacturer's label. Only mechanics skilled at such work shall apply materials. Insulation and materials shall be by one of the manufacturers listed. Specialty material shall be of the manufacturer indicated or approved equal. Fire and smoke hazard classification ratings on insulation, jacket, and adhesive shall conform to NFPA 255, ASTM E 84, or UL-723 as follows:

1. Flame Spread Index not exceeding 25.
2. Fuel Contributed not exceeding 50.
3. Smoke Developed Index not exceeding 50.

B. Certifications: Submit certifications or other data as necessary to show compliance with these specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

C. Manufacturers: Firms regularly engaged in manufacture of plumbing insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

D. Subject to compliance with requirements, provide products of one (1) of the following manufacturers:

1. Armacell LLC
2. Dow Chemical Company
3. Einsulation, Inc.
4. Johns-Manville Corp.
5. Keene Corp.
6. Knauf Fiber Glass
7. Owens-Corning Fiberglass Corp.
8. Rubatex Corp.
9. Pittsburg Corning Corp.

E. Thermal Conductivity Average Maximum in Btu-in/hr-ft^2 at 75°F Mean Temperature:

1. Fiberglass Board = 0.26.
2. Fiberglass Blanket = 0.30.
3. Fiberglass Preformed Pipe Insulation = 0.26.
4. Cellular Glass = 0.30.
5. Flexible Elastomeric Cellular = 0.27.
6. Polyisocyanurate = 0.19.
7. Calcium Silicate = 0.60 @ 500°F.

F. Vapor retarder film and tape shall have a maximum permeance of 0.030 perm.

PART 2 - PRODUCTS

2.1 PIPING SYSTEM INSULATION

A. Piping insulation shall be as scheduled below:

	SYSTEM	PIPE SIZE AND LOCATION	INSULATION AND JACKET
1.	Domestic Cold Water (including HVAC Make-up Lines)	Piping in building through 1-1/4-inch	1/2-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket.
2.	Domestic Cold Water (including HVAC Make-up Lines)	Piping in building 1-1/2 inch and larger	1-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket.
3.	Domestic Hot and Recirculated Hot Water	Piping in building through 1-1/4-inch	1/2-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket.
4.	Domestic Hot and Recirculated Hot Water	Piping in building 1-1/2-inch and larger	1-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket.

B. All pre-formed fiberglass and elastomeric closed-cell plastic foam pipe insulation shall be provided with self-adhering and self-sealing overlapping flap.

C. Handicapped Lavatory Drain and P-Trap Assembly and Hot and Cold Water Supply Pipe and Valve Assembly: Insulate handicap lavatory P-trap and angle valve assemblies with the premolded assembly as manufactured by "Truebro" Lav-Guard, Plumberex Pro-Extreme, or approved equal, white color with 3-piece interlocking trap assembly and interlocking angle valve assemblies. Fasteners shall be nylon-type supplied with kit.

D. Insulation of Piping Specialties on Cold Piping Services: Insulate unions, flanges, strainers, flexible connections, hoses, and expansion joints on cold piping services with flexible elastomeric cellular insulation. Thickness of elastomeric cellular insulation shall be equivalent to thickness of insulation on the piping service as specified in this Section or as shown on the drawings. Insulation shall be sealed to provide a vapor tight barrier. Cold piping services include domestic cold water systems.

E. Piping Insulation Omitted:

1. Insulation Omitted Plumbing Systems: Omit insulation on exposed plumbing fixture runouts from faces of wall or floor to fixture; on unions, flanges, strainers, flexible connections, and expansion joints.

F. Insulation Protection:

1. Pipe insulation exposed in finished areas shall be protected with 0.030-inches thick ABS plastic jacketing covers, Ceel-Co 100 Series or approved equal.

2. Pipe insulation exposed in equipment rooms, indoor parking garages and other unfinished areas shall be protected with 0.030-inches thick, ultraviolet resistant, PVC plastic jacketing covers, Ceel-Co 300 Series or approved equal.

3. Pipe insulation exposed to weather shall be protected with a pre-fabricated self-adhering and self-sealing sheet type waterproof membrane. Membrane shall be installed according to manufacturer's recommendations for the application at hand. The waterproof membrane shall be Flex-Clad 400 as manufactured by MFM Building Products Corporation of Coshocton, OH or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with the MICA National Commercial and Industrial Insulation Standards to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to testing and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. The appearance of the completed insulation shall be a significant factor in determining the acceptability of the work.

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

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

F. Where vapor retarders are specified, elbows and fittings shall be wrapped with vapor retarder tape 3-inches wide or shall have PVC jacketing.

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

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

I. Insulated piping systems shall be supported on the exterior of the insulation surface. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

J. Metal shields: Conform to table below for minimum length of shield:

PIPE SIZE	INSULATION THICKNESS	LENGTH OF SHIELD
Less than 1″	Up to 1″	3″
1″ – 2″	1″	4 1/2″
1″ – 2″	1 1/2″	5 1/2″

K. Pipe Hanger, Trapeze, and Roller Support Insulation Inserts: Butt pipe insulation against pipe hanger insulation inserts. Apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3-inch wide vapor barrier tape or band.

3.2 PROTECTION AND REPLACEMENT

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

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

END OF SECTION

SECTION 22 10 00

PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of plumbing piping and equipment is indicated on drawings and schedules, and by requirements of this Section.

B. Types of plumbing piping and equipment specified in this Section include the following:

1. Potable Water Piping.
2. Soil and Waste Piping.
3. Plumbing Equipment:

a. Backflow Preventers
b. Water Hammer Arresters
c. Thermostatic Mixing Valves
d. Emergency Tempering Valves
e. Drainage Piping Products
f. Automatic Flow Control Valves

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing piping and equipment–of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with plumbing piping, and equipment work similar to that required for project.

C. Codes and Standards:

1. Plumbing Code Compliance: Comply with applicable portions of Local, City, and State Plumbing Code pertaining to plumbing materials construction and installation of products.

2. ADA Compliance: Comply with applicable portions of American Disability Act for material construction and installation of products.

3. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of plumbing piping, fixtures, and equipment.

4. UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which comply with UL and NEMA standards:

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's plumbing piping and equipment specifications, including installation and start-up instructions, and capacity and ratings, with selection points clearly indicated.

B. Shop Drawings: Submit assembly type shop drawings indicated dimensions, weights, required clearances, and methods of assembly of all components.

C. Wiring Diagrams: Submit ladder-type wiring diagrams for all components, clearly indicating all required field electrical connections.

D. Maintenance Data: Submit maintenance data and parts lists for each item of plumbing piping and equipment. Include "trouble-shooting" maintenance guides. Include this data in maintenance manual.

E. Record Drawings: At project closeout, submit record drawings of installed plumbing piping systems.

1.4 WARRANTY

A. General Warranty: The special warranty 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

2.1 MATERIALS AND PRODUCTS

A. General: Provide plumbing piping materials and equipment products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with applicable Plumbing Codes. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems. Where more than one (1) type of materials or products is indicated, selection is Installer's option.

2.2 POTABLE WATER PIPING

(Pipe material selected shall be in compliance with all applicable codes.)

A. Interior Water Piping:

1. Tube Size 2-inch (50mm) and Smaller: Copper tube; Type L, hard-drawn temper; wrought-copper fittings, solder-joints.

2. Tube Size 2-1/2-inch (65mm) and Larger: Copper tube; Type L, hard-drawn temper; wrought-copper fittings, solder-joints.

B. Exterior Water Piping and Piping Under Floor Slab:

1. Tube Size 3/4-inch (19mm) and Smaller: Copper tube; Type K, soft-annealed temper; cast-copper flared tube fittings.

2. Tube Size 1-inch (25mm) through 2-1/2-inch (65mm): Copper tube; Type K, soft-annealed temper; wrought-copper fittings, solder-joints.

2.3 SOIL, WASTE AND STORM PIPING

(Pipe material selected shall be in compliance with all codes.)

A. Aboveground Soil, Waste, Vent and Storm Piping:

1. Cast-Iron Soil Pipe: ASTM A 888 and CISPI Standard 301, Service weight, hub-and-spigot cast-iron soil pipe and fittings, with neoprene compression gaskets conforming to ASTM C 564. All cast iron soil pipe and fittings shall be marked with collective trademark of the Cast Iron Soil Pipe Institute and list by NSF International.

2. Hubless Cast-Iron Soil Pipe: CISPI Standard 301, Service weight, cast-iron soil pipe and fittings, with stainless steel shields and neoprene gaskets conforming to CISPI Standard 310. All cast iron soil pipe and fittings shall be marked with collective trademark of the Cast Iron Soil Pipe Institute.

3. Copper Tube: ASTM B 306, Type DWV for pipe, and cast-bronze, drainage pattern fittings, with soldered joints.

    a. Solder Filler Materials: ASTM B 32, 50-50 tin-lead solder.

4. PVC, Type DWV Pipe and Fittings: ASTM D 2665 pipe and fittings, with solvent cemented joints; DWV plastic fitting patterns shall conform to ASTM D 3311.

    a. Solvent: ASTM D 2564.

2.4 PLUMBING EQUIPMENT

A. Backflow Preventers: Reduced pressure principle assembly consisting of shutoff valves on inlet and outlet, and strainer on inlet. Assemblies shall include test cocks, and pressure-differential relief valve located between two (2) positive seating check valves, and comply with requirements of ASSE Standard 1013.

1. Manufacturers: Subject to compliance with requirements, provide backflow preventer of one (1) of the following:

    a. Conbraco.
    b. Febco Sales, Inc.; Subs of Charles M. Bailey Co., Inc.
    c. Hersey Products, Inc.
    d. ITT Lawler; Fluid Handling Div.
    e. Watts Regulator Co.
    f. Zurn/Wilkins.

B. Water Hammer Arrestors: Bellows type, with stainless steel casing and bellows, pressure rated for 250 PSI, tested and certified in accordance with PDI Standard WH-201.

1. Manufacturers: Subject to compliance with requirements, provide water hammer arrestors of one (1) of the following:

    a. Amtrol, Inc.
    b. Josam Co.
    c. Mifab, Inc.
    d. Smith (Jay R.) Mfg. Co.
    e. Wade Division of Tyler Corp.

f. Zurn Industries, Inc.; Hydromechanics Div.
g. Precision Plumbing Products, Inc.
h. Watts Drainage Products.

C. Emergency Tempering Valves: Thermostatic mixing valve for supplying tepid water to emergency fixtures. Valve shall have bronze body construction with corrosion resistant components and shall employ a liquid-filled temperature element with dual internal cold water bypass mechanism. Dirt resistant poppet and seat design, strainer checkstops for each valve and tamper-resistant temperature adjustment screw.

1. Mounting: Universal mounting capability.

2. Manufacturer: Subject to compliance with requirements, provide thermostatic mixing valves of one (1) of the following:

a. Bradley Corp.
b. Lawler Manufacturing.
c. Leonard Valve Co.
d. Powers HydroGuard.
e. Symmons Industries, Inc.

D. Drainage Piping Products:

1. General: Provide factory-fabricated drainage piping products of size and type indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and governing regulations.

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

3. Floor Cleanouts: Cast-iron body and frame; cleanout plug; adjustable round top as follows:

4. Nickel-Bronze Top: Manufacturer's standard cast unit of the pattern and proper recess to fit floor finish.

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

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

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

E. Automatic Flow Control Valves: Class 150, cast-iron housing, stainless steel operating parts; threaded connections for 2-inch and smaller, flanged connections for 2-1/2-inch and larger. Factory set to automatically control flow rates within plus or minus 5% design, while compensating for system operating pressure differential. Provide Y-strainer upstream of valve inlet. Provide pressure/temperature ports on inlet and outlet for flow measuring equipment. Provide a metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and rate flow in GPM.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine areas and conditions under which plumbing piping, fixtures, and equipment are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF POTABLE, WASTE, AND VENT PIPING

A. General: Install plumbing piping in accordance with all applicable specifications, and in compliance with manufacturer's recommendations.

B. Potable, waste, and vent piping shall not be installed within any fire resistive rated assembly wall of two (2) hours or greater.

C. If plastic pipe is used, provide fire stopping at all floor penetrations with firestop collars and firestop sealant, STI SpecSeal or approved equal.

D. Plastic pipe shall not be installed in Kitchens or Laundry Rooms and in any piping system containing or receiving drainage of liquids at temperatures over 140°F. Plastic pipe shall not be installed in supply or return air plenums.

E. Cleanouts for soil, waste, and storm piping:

1. Install in above ground piping and building drain piping as indicated, as required by all applicable Plumbing Codes; and at each change in direction of piping greater than 90°; at minimum intervals of 50-feet for piping 4-inch and smaller and 100-feet for piping larger than 4-inch; and at base of each vertical soil or waste stack.

2. Provide on grade, exterior dual cleanouts on all building storm drains and building sanitary drains. Cleanouts shall be located within 5-feet of exterior wall of building, shall be heavy duty type and shall be set in 24-inch x 24-inch thick concrete pad.

3. Provide access to all cleanouts. Install floor and wall cleanout covers or access panels/doors for concealed piping, select type to match adjacent building finish and as required for wall fire rating.

F. Slope for Soil, Waste, and Vent Piping: Install piping pitched to drain at uniform slope not less than that indicated by governing plumbing code, or at a minimum, the following:

1. Pipe Size 3-inch and Smaller: 1/4-inch per foot (2% slope).
2. Pipe Size 4-inch to 6-inch: 1/8-inch per foot (1% slope).
3. Pipe Size Larger than 6-inch: 1/16-inch per foot (0.5% slope).

G. Solder Joints in Potable Water Systems: All solder for joints in potable water systems shall contain less than 0.2% lead and shall be 95% tin, 5% antimony as manufactured by M.C. Canfield and Sons of Union, New Jersey or approved equal.

H. Hanger and Supports: Conform to table below for maximum spacing of supports:

PIPE MATERIAL	HORIZONTAL IN FEET	VERTICAL IN FEET
Cast-Iron Soil Pipe	5	15
Copper Tubing – 1-1/4-Inches and Smaller	6	10
Copper Tubing - 1-1/2-Inches and Larger	10	10
PVC Plastic Pipe	4	4
Steel Pipe	12	15

I. Waste, Vent, and Water Connections:

1. The minimum size of waste, vent, and water connections to the individual fixtures shall be as follows:

Fixtures	Waste	Vent	C.W.	H.W.
Water Hydrants			3/4"	

2. The minimum size of underfloor waste connection from any individual fixture shall be 2-inch pipe size, regardless of waste connection size to the fixture.

J. Floor Drains: Set drain elevation depressed below finished slab elevation as listed below with coordination with general construction and architectural drawings to provide proper slope to drain:

DEPRESSION IN INCHES	RADIUS OF AREA DRAINED – FEET
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

1. Trap all drains connected to the sanitary sewer.

2. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

3. Coordinate drain location with equipment served.

3.3 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS

A. Where plans indicate fixtures to be furnished by others, this Contractor shall provide all rough-in, furnish P-traps, stops and supplies and shall connect such fixtures to the plumbing system. Traps and tailpieces shall be of the same material as the pipe.

B. Pipe and fittings exposed in finished areas shall be chrome plated.

3.4 INSTALLATION OF PLUMBING EQUIPMENT

A. Backflow Preventers: Install backflow preventers at water service entrance and at each connection to mechanical equipment and systems, and in compliance with the plumbing code and authority having jurisdiction. Locate backflow preventer serving equipment in same room as equipment being connected. Pipe relief outlet without valves, to nearest floor drain.

B. Water Hammer Arrestors: Install water hammer arrestors with isolation valve for all quick-closing type valves. Locate water hammer arrestors per manufacturer's recommendations.

C. Emergency Tempering Valves: Install emergency tempering valve with inlet stops and discharge thermometer and shutoff valve. Provide hot water and cold water connections into tempering valve as recommended by manufacturer.

3.5 FIELD QUALITY CONTROL

A. General: Do not enclose, cover, or put into operation piping systems until they have been inspected and approved by the authority having jurisdiction.

B. Inspect, test, and purge natural gas systems according to NFPA 54, Part 4 "Gas Piping Inspection, Testing, and Purging" and Local Gas Utility requirements.

1. Repair leaks and defects with new materials, and retest system until satisfactory results are obtained.

2. Report test results promptly and in writing to the Architect and the authority having jurisdiction.

C. Test water distribution piping as follows:

1. Test for leaks and defects in new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of system tested.

2. Leave uncovered and unconcealed in new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved for testing.

3. Cap and subject the piping system to a static water pressure of 50 PSIG above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four (4) hours. Leaks and loss in test pressure constitute defects that must be repaired.

4. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

D. Drainage and Vent Piping System Tests: Test drainage and vent systems according to procedures or authority having jurisdiction or, in absence of published procedure, as follows:

1. Test for leaks and defects in new drainage and vent piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed in new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose for testing work that has been covered or concealed before it has been tested and approved.

3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open-jointed drain tile, test piping of plumbing drainage and venting systems on completion of roughing-in piping installation. Tightly close all openings in piping system and fill with water to point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and their traps filled with water, test connections and prove gastight and watertight. Plug stack openings on roof and building drain where it leaves the building and introduce air into the system equal to pressure of 1-inch water column. Use a U-tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects, using new materials and retest system or portion thereof until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

3.6 CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge new potable water distribution piping systems and parts of existing potable water systems that have been altered, extended, or repaired prior to use.

2. Use purging and disinfecting procedure prescribed by authority having jurisdiction or, if a method is not prescribed by that authority, the procedure described in either AWWA C 651 or AWWA C 652 or as described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Fill system or part thereof with water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) and allow to stand for 24 hours.

c. Drain system or part thereof of previous solution and refill with water/chlorine solution containing at least 200 parts per million of chlorine. Isolate and allow to stand for three (3) hours.

d. Flush system with clean, potable water until chlorine does not remain in water coming from system following allowed standing time.

e. Submit water samples in sterile bottles to authority having jurisdiction. Repeat procedure if biological examination made by the authority shows evidence of contamination.

3.7 COMMISSIONING

A. Piping Systems and Fixtures:

1. Fill water piping. Check components and fixtures to determine that they are not air bound and that piping is full of water.

2. Perform the following steps before putting into operation:

    a. Close drain valves, hydrants, and hose bibbs.

    b. Open shutoff valves to fully open position.

    c. Open throttling valves to proper setting.

    d. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.

    e. Remove and clean strainer screens. Close drain valves and replace drain plugs.

3. Energize pumps and verify proper operation.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of plumbing fixtures is indicated on drawings and schedules, and by requirements of this Section.

B. Types of plumbing fixtures, specified in this Section include the following:

1. Plumbing Fixtures.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fixtures, of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with plumbing piping, fixtures, and equipment work similar to that required for project.

C. Codes and Standards:

1. Plumbing Code Compliance: Comply with applicable portions of Local, City, and State Plumbing Code pertaining to plumbing materials construction and installation of products.

2. ADA Compliance: Comply with applicable portions of American Disability Act for material construction and installation of products.

3. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of plumbing piping, fixtures, and equipment.

4. UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which comply with UL and NEMA standards:

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's plumbing fixture specifications, including installation and start-up instructions, and capacity and ratings, with selection points clearly indicated.

B. Shop Drawings: Submit assembly type shop drawings indicated dimensions, weights, required clearances, and methods of assembly of all components.

C. Maintenance Data: Submit maintenance data and parts lists for each item of plumbing piping, fixtures, and equipment. Include "trouble-shooting" maintenance guides. Include this data in maintenance manual.

1.4 WARRANTY

A. General Warranty: The special warranty 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

2.1 MATERIALS AND PRODUCTS

A. General: Provide factory-fabricated fixture products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with applicable Plumbing Codes. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems. Where more than one (1) type of materials or products is indicated, selection is Installer's option.

2.2 PLUMBING FIXTURES

A. General: Provide factory-fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by manufacturer, and as required for a complete installation. Where more than one (1) type is indicated, selection is Installer's option; but all fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.

B. Materials: Unless otherwise specified, comply with applicable Federal Specification WW-P-541/-Series sections pertaining to plumbing fixtures, fittings, trim, metals and finishes. Comply with requirements of WW-P-541/-specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps, and vacuum breakers, even though some plumbing fixtures specified in this Section are not described in WW-P-541/-.

C. Supplies and Stops: All fixtures shall be provided with supplies with stops.

1. Stops shall be chrome-plated solid brass with brass stems and chloramine-chlorine resistant washers. Stops shall be keyed when installed in public restrooms.

2. Supplies shall be chloramine-chlorine resistant braided stainless steel flexible connectors.

D. Traps: Traps shall be provided for all fixtures without integral traps.

1. P-traps shall be adjustable chrome plated heavy cast brass with 17 gauge tubular wall end, brass slip nuts, and brass flanges.

2. Sink end waste kits shall have cast brass tee and 17 gauge tubular waste arm and brass slip nuts.

E. Fixture Schedules: Comply with fixture requirements contained in fixture schedule as indicated on drawings. Plumbing fixtures shall be of one (1) of the manufacturers indicated and in accordance with the information and manufacturer's catalog numbers indicated. Where

manufacturer's catalog numbers have been updated or deleted, fixtures shall be of similar configuration and of similar or better quality than that indicated.

F. Manufacturer: Subject to compliance with requirements, provide plumbing fixtures and trim of one (1) of the following:

1. Floor Drains, Roof Drains, Interceptors, and Drainage Piping Products:

a. Josam Mfg. Co.
b. Mifab, Inc.
c. Smith (Jay R.) Mfg. Co.
d. Wade Div., Tyler Pipe.
e. Watts Drainage Products.
f. Zurn Industries, Hydromechanics Div.

2. Hose Bibbs, Wall Hydrants, Yard Hydrants:

a. Josam Mfg. Co.
b. J.R. Smith Mfg. Co.
c. Wade Div., Tyler Pipe.
d. Watts Drainage Products.
e. Woodford Mfg. Co.
f. Zurn Industries.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine areas and conditions under which plumbing fixtures are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PLUMBING FIXTURES

A. General: Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of the National Uniform Code pertaining to installation of plumbing fixtures.

B. Fasten plumbing fixtures securely to indicated supports or building construction; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement.

C. Supplies and Stops: All fixtures shall be provided with supplies with stops.

D. Traps: Provide traps for all fixtures without integral traps.

3.3 COMMISSIONING

A. Piping Systems and Fixtures:

1. Fill water piping. Check components and fixtures to determine that they are not air bound and that piping is full of water.

2. Perform the following steps before putting into operation:

   a. Close drain valves, hydrants, and hose bibbs.

   b. Open shutoff valves to fully open position.

   c. Open throttling valves to proper setting.

   d. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.

   e. Remove and clean strainer screens. Close drain valves and replace drain plugs.

3. Check plumbing specialties and verify proper settings, adjustments and operation.

END OF SECTION

SECTION 23 00 00

MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section applies to all mechanical work.

B. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to all mechanical work.

C. Each specification section within their respective Division shall be coordinated with all other sections in that division for related work.

D. The project documents contemplate the complete installation of the systems described herein, or shown on the drawings, so that at the conclusion of the construction, the systems will be turned over to the Owner complete and ready for safe, efficient operation.

E. The Contractor shall be obliged to furnish and install all such items normally included on systems of this type, which while not mentioned directly herein are obviously essential to the installation and operation of the systems, and which are normally furnished on installations of this type.

1.2 COORDINATION OF WORK

A. General: The Contractor shall recognize that the Contract Documents are diagrammatic in showing certain physical relationships that must be established within the mechanical and electrical work, and in its interface with other work including utilities and that such establishment is the exclusive responsibility of the Contractor. This Contractor shall be responsible for work fitting in place without conflict with other trades, where proper planning could avoid interference. This Contractor shall examine the locations and verify all measurements, distances, elevations and existing conditions before starting work. Because the drawings are diagrammatic and on a small scale, all rises, drops, offsets, etc., have not been shown. The Contractor shall agree to provide and install the necessary piping, fittings, valves, ducts, duct fittings and offsets, and other specialties to suit such conditions without additional cost to the Owner. Mechanical drawings shall not be used for general construction dimensions or for type of material used for general construction. For exact building layout, dimensions and building materials used, Contractor shall refer to Architectural Drawings.

1.3 QUALITY ASSURANCE

A. Contractor shall comply with all State, and local codes and ordinances.

B. Contractor shall make application for, obtain and pay for all required permits and certificates of inspection of the work.

C. All equipment, materials, and installation procedures shall comply with standards listed within each specification.

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

E. Install equipment and materials to provide required access for servicing and maintenance.

1.4 SUBMITTALS

A. Maintenance and Operation Manuals:

1. Prepare and submit three (3) copies of maintenance and operation instructions for all mechanical equipment furnished. Organize maintenance and operating manual information into suitable sets of manageable size, and bind into individual binders properly identified and indexed (thumb-tabbed). Include emergency instructions, spare parts listing, copies of warranties, wiring diagrams, recommended "turn-around" cycles, inspection procedures, shop drawings, product data, signed letters of certification of inspection and similar application information. Bind each manual of each set in a heavy-duty 2-inch, 3-ring vinyl-covered binder, and include pocket folders for folded sheet information. Mark identification on both front and spine of each binder.

B. Record Drawings:

1. Provide one (1) set of mechanical drawings marked-up with actual installation locations. Give special attention to the complete and accurate recording of underground conduit, piping and ductwork, other concealed and non-accessible work, branching arrangement and valve location for piping systems, locations of dampers and coils in duct systems, locations of control system sensors and other control devices, and work of change orders where not shown accurately by Contract Documents.

C. Contract Document Discrepancies:

1. If Contract Document requirements appear to make it impossible to produce first class work, or should discrepancies appear among Contract Documents, request interpretation before proceeding with work. If Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out work in satisfactory manner. Should conflict occur in or between drawings and specifications, Contractor is deemed to have estimated on more expensive way of doing work unless he shall have asked for and obtained written decision before submission of proposal as to method or materials required.

D. The Contractor shall be responsible for and bear any expense of alterations to the building or its appurtenances resulting from the substitution of equipment to that specified in the Contract Documents.

E. Review of shop drawings does not release the Contractor from further satisfactory operating responsibilities. Material and equipment shall still be required to meet the requirements of the Construction Documents and shall be approved for final acceptance when construction is completed and all units and systems have been operated, tested, adjusted and balanced to the satisfaction of the Architect/Engineer. Should proposed approved alternate equipment involve rearrangement of designed equipment, a complete layout of the area involved shall be submitted by the Contractor, and shall be approved in writing before installation of any such items of equipment. Any additional expense involved shall be a Contractor-borne expense.

1.5 FEES, PERMITS, LICENSES, UTILITY CONNECTION CHARGES, AND UTILITY COST

A. The Contractor shall obtain and pay for all fees, permits, licenses, utility connection charges (water, sanitary sewer, storm sewer and gas) and utility cost for services to the building required.

Capital facilities utility service charges are to be paid directly by Owner, not part of the Construction Contract.

B. The Contractor shall maintain all necessary signal lights and guards against danger and use all proper means for the safety of the public.

C. The Contractor shall pay for opening and repairing all pavement cuts.

D. The Contractor shall furnish to the Architect/Engineer copies of all fees, permits and licenses required for all mechanical work herein specified before any mechanical work is started.

1.6 AUTOCAD DRAWING FILE REQUESTS

A. As an instrument of service to aid in Shop Drawing Submittals, Farris Engineering (FEI) will provide AutoCAD drawing files upon request. The files will be sent upon return receipt of the "Request for Drawings" agreement signed by an officer of the requesting firm. FEI does not assure that the drawings represent all changes, addenda items, change orders or modifications that may have occurred. The drawings are simply a tool for use in producing shop drawing submittals.

B. The drawing files will be "cleaned-up" by having the FEI logo, Professional Engineer seal, and all extraneous notes and details removed. FEI must be compensated for this additional service by the requesting firm. A minimum fee of $200.00 for up to eight (8) sheets and $25.00 per sheet for each additional requested drawing will be invoiced to the requesting firm once the signed agreement is received.

1.7 ELECTRICAL COORDINATION

A. General: Mechanical Contractor shall coordinate with Electrical Contractor for proper electrical power characteristics to all mechanical equipment which require electrical power connection. Unless specifically shown otherwise Electrical Contractor shall provide all power connections required to provide power to the equipment and Mechanical Contractor shall provide all equipment and electrical wiring required for all start-stop control and safety interlock functions required for all equipment.

B. Types of work, normally recognized as electrical but provided as mechanical, specified or partially specified in this section, include but are not necessarily limited to the following:

1. Motors for mechanical equipment.

2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment and for all 2-speed motors. All 2-speed starters to be provided with time delay between high and low speed.

3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.

4. Furnish and install all electrical control circuit conduits and wiring and control devices required to perform the equipment control functions, including float control switches, flow control switches, and similar mechanical/electrical devices provided for mechanical systems.

C. Emergency Shutdown Switches: Mechanical Contractor shall coordinate with Electrical Contractor for proper shutdown switches to all mechanical, kitchen or foodservice equipment which require emergency shutdown. Types of equipment provided by mechanical, kitchen or foodservice equipment suppliers, include but are not necessarily limited to the following:

1. Air Handling Units.

D. Mechanical/Electrical Coordination Schedule: See schedule on drawings for further Mechanical/Electrical coordination requirements.

1.8 ELECTRIC MOTORS

A. Basic Motor Requirements

1. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.

2. Motors 1 HP and Larger: Polyphase.

3. Motors smaller than 1 HP: Single-phase.

4. Frequency Rating: 60 Hz.

5. Voltage Rating: Determined by voltage of circuit to which motor is connected.

6. Service Factor: According to NEMA MG 1, unless otherwise indicated.

7. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

8. Enclosure: Open dripproof, unless otherwise indicated.

B. Polyphase Motors:

1. Description: NEMA MG-1, medium induction motor.

a. Design Characteristics: NEMA MG-1, Design B, unless otherwise indicated.

b. Premium Energy-Efficient Design: All motors.

c. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.

d. Rotor: Squirrel cage, unless otherwise indicated.

e. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

f. Temperature Rise: Match insulation rating, unless otherwise indicated.

g. Insulation: Class F, unless otherwise indicated.

2. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.

3. Motors Used with Variable-Frequency Controllers: Definite-purpose inverter-fed motors in accordance with NEMA MG-1, Part 31. Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

   a. Critical vibration frequencies are not within operating range of controller output.

   b. Temperature Rise: Match rating for Class B insulation.

   c. Insulation: Class H.

   d. Thermal Protection: Where indicated, conform to NEMA MG-1 requirements for thermally protected motors.

4. Rugged-Duty Motors: Where indicated, motors are totally enclosed with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings are insulated with non-hygroscopic material. External finish is chemical-resistant paint over corrosion-resistant primer.

5. Source Quality Control: Perform the following routine tests according to NEMA MG-1:

   a. Measurement of winding resistance.
   b. No-load readings of current and speed at rated voltage and frequency.
   c. Locked rotor current at rated frequency.
   d. High-potential test.
   e. Alignment.

C. Single-Phase Motors:

1. Type: As indicated or selected by manufacturer from one (1) of the following, to suit starting torque and other requirements of specific motor application.

   a. Permanent-split capacitor.
   b. Split-phase start, capacitor run.
   c. Capacitor start, capacitor run.

2. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 HP.

3. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.

4. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, prelubricated sleeve bearings for other single-phase motors.

1.9 CLEANING AND PROTECTION

A. General: During handling and installation of work at project site, each Contractor shall clean and protect work in progress and adjoining work on a basis of perpetual maintenance. Apply suitable

protective covering on newly installed work where reasonably required to ensure freedom from damage or deterioration at time of substantial completion; otherwise, clean and perform maintenance on newly installed work as frequently as necessary through remainder of construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

1.10 TEMPORARY HEATING, COOLING AND VENTILATION

A. Existing mechanical systems may be used for temporary heating, cooling and ventilation during construction. New mechanical systems shall not be used for temporary heating, cooling and ventilation. All costs associated with providing temporary heating, cooling and ventilation during construction shall be the responsibility of the Contractor.

1.11 PROJECT CLOSEOUT

A. Closeout Equipment/Systems Operations: Sequence operations properly so that work of project will not be damaged or endangered. Coordinate with seasonal requirements. Operate each item of equipment and each system in a test run of appropriate duration with the Owner's operating personnel present, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance. Clean and lubricate each system, and replace dirty filters, excessively worn parts and similar expendable items of the work.

B. Operating Instructions: Conduct a full-day walk-through instruction seminar for the Owner's personnel to be involved in the continued operation and maintenance of mechanical equipment and systems. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar features of the systems.

1.12 FINAL COMPLETION

A. The Mechanical Contractors shall not call for a final completion check until the entire Mechanical and Electrical Equipment and Systems have been installed, adjusted, balanced and in full and complete satisfactory operation and the following certifications of inspection from equipment suppliers have been completed and submitted to the Architect/Engineer. Certifications of Inspections for Mechanical Equipment are required on the following items of equipment:

1. Plumbing fixtures & equipment (Local Rep).
2. Condensing Units (Local Rep).
3. Air Handling Units (Local Rep).
4. Air terminal devices (Factory Rep).
5. Fans (Local Rep).
6. Temperature control equipment (Manufacturer).

B. The Certifications shall consist of letters signed by Factory-Trained and -Authorized Service Engineers stating the following:

1. They have inspected all of their equipment on the project.

2. They approve the condition of the equipment and its installation.

3. They have fully checked its operation and certify that it is operating properly.

4. They have noted any problems, conditions or objections that could lead to future operating problems.

C. Documentation of the signed letters of Certification of Inspection shall be furnished in the Operations and Maintenance Manuals, included with the associated equipment.

1.13 FINAL PAYMENT

A. Final Payment will not be made until the Contractor has satisfactorily completed all final inspection items.

1.14 GUARANTEE

A. The one (1) year guarantee period shall not start until the project is fully completed and the Contractor has received the Final Payment and Certificate of Completion.

B. All equipment and all work shall be fully guaranteed, parts, and labor, for one (1) full year from the date of the Certificate of Completion. Repairs made during this period must be fully guaranteed for an additional one (1) year period from the date of repairs.

C. The Mechanical Contractor has the full responsibility to guarantee all equipment and work and shall assume full responsibility to repair any equipment at his cost that the manufacturer refuses to guarantee.

D. The Owner has the right to order repairs to any equipment or work provided hereon and to charge the Contractor for same if repairs are not made by the Contractor within a reasonable period of time not to exceed 24 hours during an emergency or 72 hours on a non-critical item.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PAINTING AND FINISHING

A. Painting of exposed mechanical work is specified and performed under other divisions of these specifications.

B. Factory finishes, shop priming, and special protective coatings are specified in the individual equipment specification sections.

C. Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

D. Paint inside of ductwork black, where it can be seen from occupied spaces through diffusers, grilles or louvers (under any lighting condition).

END OF SECTION

SECTION 23 01 30

NADCA GENERAL SPECIFICATIONS

PART 1 - SPECIAL PROVISIONS

1.1 QUALIFICATION OF THE HVAC SYSTEM CLEANING CONTRACTOR

A. Membership: The HVAC System Cleaning Contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA) or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.

B. Certification: The HVAC System Cleaning Contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.

C. Supervisor Qualifications: A person certified as an ASCS by NADCA or maintaining an equivalent certification by a nationally recognized program and organization shall be responsible for the total work herein specified.

D. Experience: The HVAC System Cleaning Contractor shall submit records of experience in the field of HVAC system cleaning as requested by the Owner. Bids shall only be considered from firms that are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

E. Equipment, Materials and Labor: The HVAC System Cleaning Contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services.

1. The Contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures and manufacturer's product and material safety data sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration and as described by this specification. For work performed in countries outside of the U.S.A., Contractors should comply with applicable National Safety Codes and Standards.

2. The Contractor shall maintain a copy of all current MSDS Documentation and Safety Certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA Programs and this specification

3. Contractor shall submit to the Owner all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.

F. Licensing: The HVAC System Cleaning Contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. Contractor shall comply with all Federal, state and local rules, regulations and licensing requirements.

1.2 STANDARDS

A. NADCA Standards: The HVAC System Cleaning Contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).

1. All terms in this specification shall have their meaning defined as stated in the NADCA Standards.

2. NADCA Standards must be followed with no modifications or deviations being allowed.

1.3 DOCUMENTS

A. Mechanical Drawings: The Owner shall provide the HVAC System Cleaning Contractor with one (1) copy of the following documents:

1. Project drawings and specifications

2. Approved construction revisions pertaining to the HVAC system

3. Any existing indoor air quality (IAQ) assessments or environmental reports prepared for the facility.

PART 2 - HVAC SYSTEM CLEANING SPECIFICATIONS AND REQUIREMENTS

2.1 SCOPE OF WORK

A. Scope: This section defines the minimum requirements necessary to render HVAC components clean and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.

B. The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

C. The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts (except ceiling plenums and mechanical room) to the air handling unit (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, humidifiers and dehumidifiers, supply air ducts, fans, fan housing, fan blades, air wash systems, spray eliminators, turning vanes, filters, filter housings, reheat coils and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

Note: Users of this specification must modify the above paragraph to succinctly and specifically define those systems and components requiring cleaning.

2.2 HVAC SYSTEM INSPECTIONS AND SITE PREPARATIONS

A. HVAC System Evaluation: Prior to the commencement of any cleaning work, the HVAC System Cleaning Contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools and equipment required to satisfactorily complete this Project.

1. Damaged system components found during the inspection shall be documented and brought to the attention of the Owner.

B. Site Evaluation and Preparations: Contractor shall conduct a site evaluation and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the Project.

2.3 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

A. Containment: Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.

B. Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.

C. Controlling Odors: All reasonable measures shall be taken to control offensive odors and/or mist vapors during the cleaning process.

D. Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards (see NADCA Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.

E. Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.

F. Service Openings: The Contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and inspection.

1. Contractor shall utilize the existing service openings already installed in the HVAC system where possible.

2. Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.

3. Closures must not significantly hinder, restrict, or alter the air-flow within the system.

4. Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.

5. Openings must not compromise the structural integrity of the system.

6. Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes and applicable NFPA, SMACNA and NADCA Standards.

7. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.

8. Rigid fiberglass ductboard duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques which comply with UL Standard 181 or UL Standard 181a are suitable for fiberglass duct system closures.

9. All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the Owner in project report documents.

G. Ceiling sections (tile): The Contractor may remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process.

H. Air distribution devices (registers, grilles & diffusers): The Contractor shall clean all air distribution devices.

I. Air handling units, terminal units (VAV, Dual duct boxes, etc.), blowers and exhaust fans: The Contractor shall insure that supply, return and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers and drive assemblies. All visible surface contamination deposits shall be removed in accordance with NADCA Standards. Contractor shall:

1. Clean all air handling unit (AHU) internal surfaces, components and condensate collectors and drains.

2. Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.

3. Clean all coils and related components, including evaporator fins.

J. Duct Systems: Contractor shall:

1. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.

2. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Testings (see NADCA Standards).

2.4 HEALTH AND SAFETY

A. Safety Standards: Cleaning Contractors shall comply with all applicable federal, state and local requirements for protecting the safety of the Contractors' employees, building occupants and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.

B. Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.

C. Disposal of Debris. All Debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state and local requirements.

2.5 MECHANICAL CLEANING METHODOLOGY

A. Source Removal Cleaning Methods: The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the Contractor's responsibility to select Source Removal methods which will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.

1. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.

2. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.

3. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.

4. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

B. Methods of Cleaning Fibrous Glass Insulated Components:

1. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure and not permitted to get wet in accordance with applicable NADCA and NAIMA Standards and recommendations.

2. Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).

C. Damaged Fibrous Glass Material:

1. If there is any evidence of damage, deterioration, delamination, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by

cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.

2. When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.

3. Replacement material: In the event fiberglass materials must be replaced, all materials shall conform to applicable industry codes and standards, including those of UL and SMACNA.

4. Replacement of damaged insulation is not covered by this specification.

D. Cleaning of Coils:

1. Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer or erosion of the coil surface or fins and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.

E. Biocidal Agents and Coatings:

1. Biocidal agents shall only be applied if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified through testing.

2. Application of any biocidal agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.

3. Only biocidal agents registered by the U.S. Environmental Protection Agency (EPA) specifically for use within HVAC system shall be used.

4. Biocidal agents shall be applied in strict accordance with manufacturer's instructions.

5. Biocidal coating products for both porous and non-porous surfaces shall be EPA registered water soluble solutions with supporting efficacy data and MSDS records.

6. Biocidal coatings shall be applied according to manufacturer's instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces. A continuous film must be achieved on the surface to be treated by the coating application. Application of any biocidal coatings shall be in strict accordance with manufacturer's minimum millage surface application rate standards for effectiveness.

2.6 CLEANLINESS VERIFICATION

A. General: Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.

B. Visual Inspection: The HVAC system shall be inspected visually to ensure that no visible contaminants are present.

1. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the Owner reserves the right to further verify system cleanliness through gravimetric or wipe testing analysis testing as specified herein.

2. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

C. Gravimetric Analysis: At the discretion and expense of the Owner, sections of the HVAC system may be tested for cleanliness using the NADCA Vacuum Test (gravimetric analysis) as specified in applicable NADCA Standards. Levels of debris collected shall be equal to or less than acceptable levels defined in applicable NADCA Standards.

1. If gravimetric analysis determines that levels of debris are equal to or lower than those levels specified in applicable NADCA standards, the system shall be considered clean and shall have passed cleanliness verification.

2. If gravimetric analysis determines that levels of debris exceed those specified in applicable NADCA Standards, the system shall not be considered clean and those sections of the system which failed cleanliness verification shall be re-cleaned at the expense of the HVAC System Cleaning Contractor.

3. Gravimetric analysis shall be performed by a qualified third party experienced in testing of this nature.

4. Cleanliness verification shall be performed immediately after mechanical cleaning and before the HVAC system is restored to normal operation.

D. Verification of Coil Cleaning

1. Cleaning must restore the coil pressure drop to within 10% of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

2.7 PRE-EXISTING SYSTEM DAMAGE

A. Contractor is not responsible for problems resulting from prior inappropriate or careless cleaning techniques of others.

2.8 POST-PROJECT REPORT

A. At the conclusion of the Project, the Contractor shall provide a report to the Owner indicating the following:

1. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.

2. Areas of the system found to be damaged and/or in need of repair.

2.9 APPLICABLE STANDARDS AND PUBLICATIONS

A. The following current standards and publications of the issues currently in effect form a part of this specification to the extent indicated by any reference thereto:

B. National Air Duct Cleaners Association (NADCA): NADCA 1992-01, "Mechanical Cleaning of Non-Porous Air Conveyance System Components," 1992.

C. National Air Duct Cleaners Association (NADCA): "Understanding Microbial Contamination in HVAC Systems," 1996.

D. National Air Duct Cleaners Association (NADCA): "Introduction to HVAC System Cleaning Services," 1995.

E. National Air Duct Cleaners Association (NADCA) NADCA Standard 05 "Requirements for the Installation of Service Openings in HVAC Systems," 1997.

F. Underwriters' Laboratories (UL): UL Standard 181.

G. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE): Standard 62-89, "Ventilation for Acceptable Indoor Air Quality".

H. Environmental Protection Agency (EPA): "Building Air Quality" December, 1991.

I. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): "HVAC Duct Construction Standards - Metal and Flexible," 1985.

J. North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems." 1993.

END OF SECTION

SECTION 23 05 00

BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes the following basic mechanical materials and methods.

1. Piping materials and installation instructions common to most piping systems.

a. Valves:

(1) Gate
(2) Ball
(3) Globe
(4) Butterfly
(5) Check

b. Valve Tags and Schedule Frames.

c. Piping Specialties:

(1) Pipe escutcheons
(2) Pipeline strainers
(3) Pipe sleeves
(4) Dielectric unions

d. Meters and gauges:

(1) Glass thermometers
(2) Pressure gauges

e. Supports and anchors:

(1) Horizontal-piping hangers and supports
(2) Saddles and shields

2. Mechanical identification.

3. Access panels.

4. Nonshrink grout for equipment installations.

5. Joint sealers for sealing around mechanical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.

6. Installation requirements common to piping and equipment specification Sections.

7. Concrete equipment base construction requirements.

8. Mechanical demolition.

9. Cutting and patching.

10. Piping tests.

B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.

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

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

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

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

F. 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.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract.

B. Product data for following piping specialties:

1. Valves.
2. Mechanical sleeve seals.
3. Thermometers.
4. Pressure gauges.
5. Identification materials and devices.
6. Access panels.

C. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

D. Coordination drawings for access panel and door locations.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code Steel."

B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

C. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions."

D. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves."

E. FCI Compliance: Test and rate Y-type strainers in accordance with FCI 73-I "Pressure Rating Standard for Y-type strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than Y-type".

F. UL and FM Compliance: Provide meters, gauges, and supports which are UL-listed and FM approved.

G. MSS Standard Compliance: Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

H. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

I. Equipment Selection: Equipment of greater or larger power, 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. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

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

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

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

C. Coordinate the 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 prior to closing in the building.

E. Coordinate connection of electrical services.

F. 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.

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

H. Perform demolition in phases as indicated.

1.8 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:

1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

2. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.

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

2.2 JOINING MATERIALS

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

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3mm) maximum thickness, except where 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. ASME B16.20 for grooved, ring-joint, steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.

C. Solder Filler Metal: ASTM B 32.

1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95%) and silver (approximately 5%), having 0.10% lead content.

2. Alloy Sn50: Tin (50%) and lead (50%) (for use on nonpotable water systems only).

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

E. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.

1. Sleeve: ASTM A126, Class B, gray iron.
2. Followers: ASTM A 47 (ASTM A 47M), Grade 32510 or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

A. Pipe Escutcheons:

1. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

3. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

B. Low Pressure Pipeline Strainers:

1. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 PSI working pressure, with Type 304 stainless steel screens, with 3/64-inch perforations at 233 per square inch.

2. Threaded Ends, 2-inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.

3. Threaded Ends, 2-1/2-inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

4. Flanged Ends, 2-1/2-inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

5. Butt Welded Ends, 2-1/2-inches and Larger: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.

6. Grooved Ends, 2-1/2-inches and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

C. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.

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

3. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150 or 300 PSIG (1035 kPa or 2070 kPa) minimum pressure to suit system pressures.

4. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

a. Provide separate companion flanges and steel bolts and nuts for 150 or 300 PSIG (1035 kPa or 2070 kPa) minimum working pressure to suit system pressures.

5. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300 PSIG (2070 kPa) minimum working pressure at 225°F (107°C) temperature.

6. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300 PSIG (2070 kPa) working pressure at 225°F (107°C) temperature.

D. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.

E. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet-Metal: 24-gauge (0.70mm) or heavier galvanized sheet metal, 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, having plain ends and integral water stop, except where other features are specified.

2.4 VALVES

A. General: Provide factory-fabricated valves recommended by Manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with Installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Gate Valves: Comply with the following requirements:

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

2. Gate Valves - 2-Inches and Smaller: MSS SP-80; Class 150, body and union bonnet as ASTM B 62 cast bronze, threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Do not use solder end valves for hot water heating or steam piping applications.

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

C. Ball Valves: Comply with the following requirements:

1. Ball valves - 1-inch and Smaller: Rated for 150 PSI SWP pressure, 600 PSI non-shock WOG pressure; 2-piece construction, bronze body conforming to ASTM B 584 or B61, full port, 316 stainless steel ball, reinforced "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide full depth ANSI threaded ends for heating hot water. Provide 2-inch extended handles of non-thermal conductive material. Valve pressure ratings shall be cast into the body of the valve.

2. Ball Valves - 1-1/4-Inches to 2-Inches: Rated for 150 PSI SWP pressure, 600 PSI non-shock WOG pressure; 2-piece construction, bronze body conforming to ASTM B 584 or B61, full port, 316 stainless steel ball, reinforced and replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide full-depth ANSI threaded ends for heating hot water. Provide 2-inch extended handles of non-thermal conductive material. Valve pressure ratings shall be cast into the body of the valve.

D. Butterfly Valves: Comply with the following requirements:

1. Butterfly Valves - 2-1/2-Inches and Larger: MSS SP-67; 200 non-shock PSI, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with aluminum bronze disc, 400 Series stainless steel stem, and EPDM O-ring stem seals. Sizes 2-1/2-inch through 6-inches shall have 10-position lever operators with locks, and sizes 8-inch through 24-inch shall have gear operators with position indicator. Provide wafer type valve. Drill and tap valves on dead-end service or requiring additional body strength. Valve shall be capable of bi-directional dead end service with downstream flange removed at full-rated pressure.

E. Check Valves: Comply with the following requirements:

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

2. Swing Check Valves - 2-1/2-Inches and Larger: MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze

disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

3. Wafer Check Valves: Class 250, cast iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Valve shall be designed to open and close at approximately one foot differential pressure.

2.5 VALVE TAGS

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

1. Provide 1-1/2-inch diameter tags, except as otherwise indicated.
2. Fill tag engraving with black enamel.

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

2.6 VALVE SCHEDULES

A. General: Provide a valve schedule for each piping system on standard size bond paper. Schedule shall include valve identification number, piping system, size and location of valve, normal operating position and additional remarks as required. Identify valve use for emergency shutoff or similar special use.

2.7 VALVE SCHEDULE FRAMES

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

2.8 METERS AND GAUGES

A. Thermometers:

1. General: Provide thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

2. Case: Die cast aluminum finished in baked epoxy enamel or hard powder coat finish, glass or acrylic front, 9-inches long.

3. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.

4. Tube and Capillary: Blue organic-liquid filled, magnifying lens, ±1 scale division accuracy, shock mounted.

5. Scale: Satin faced, non-reflective white aluminum, permanently etched black markings.

6. Stem: Copper-plated steel, brass or die-cast aluminum, for separable socket, length to suit installation.

7. Thermometer Wells: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2-inch extension for insulated piping. Provide cap fastened to well when used in a non-permanent thermometer location.

8. Thermometer wells shall be installed at each thermometer and at each point where a temperature sensing device is required by the control specifications.

9. Range: Conform to the following:

   a. Hot Water: 30°F to 240°F with 2°F scale divisions.
   b. Dry Cooler Water: 0 deg F to 100 deg F with 2 deg F scale divisions.
   c. Chilled Water: 0 deg F to 100 deg F with 2 deg F scale divisions.

10. Acceptable Manufacturers:

   a. Marsh Gauges.
   b. Moeller Instruments.
   c. Miljoco Corporation.
   d. Weiss Instruments.

B. Pressure Gauges:

1. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

2. Type: General use, ±1% accuracy, ANSI B 40.1 Grade 1A, phosphor bronze bourdon type, bottom connection.

3. Case: Stainless steel, glass or acrylic lens, 4-1/2-inch diameter.

4. Connector: Brass, lower mount with 1/4-inch male NPT.

5. Scale: White coated aluminum, with permanently etched black markings.

6. Accessories:

   a. Provide protective coil siphon when used for steam service.
   b. Provide each gauge with a shut-off needle valve.
   c. Provide pressure snubber where spikes may be present.

7. Range: Conform to the following:

   a. Water: 0-100 PSI.

8. Acceptable Manufacturers:

   a. Marsh Gauges.
   b. Moeller Instruments.
   c. Miljoco Corporation.
   d. Weiss Instruments.

2.9 SUPPORTS AND ANCHORS

A. Horizontal-Piping Hangers and Supports:

1. General: Except as otherwise indicated, provide factory- fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one (1) of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one (1) type by one (1) manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

2. Adjustable Steel Clevis Hangers: MSS Type 1.

3. Yoke Type Pipe Clamps: MSS Type 2.

4. Steel Double Bolt Pipe Clamps: MSS Type 3.

5. Steel Pipe Clamps: MSS Type 4.

6. Pipe Hangers: MSS Type 5.

7. Trapeze type with horizontal angle iron.

B. Saddles and Shields:

1. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

2. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

3. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

4. Thermal Hanger Shields: Constructed of 360 degree insert of high density, 100 PSI, water-proofed calcium silicate, encased in 360 degree sheet metal shield. Provide assembly of same thickness as adjoining insulation.

2.10 MECHANICAL IDENTIFICATION

A. Equipment Markers:

1. General: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive or fasteners to mount on equipment.

2. Terminology: Match drawing schedules as closely as possible unless directed otherwise by Owner.

3. Data Required:

a. Equipment Description, i.e. Chilled Water Pump.

b. Schedule Mark, i.e. CWP-1.

4. Marker Size: 2-1/2- by 4-inches for main control valves; 4-1/2- by 6-inches for equipment.

B. Plastic Pipe Markers:

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

2. Small Pipes: For external diameters less than 6-inches (including insulation if any), provide full-band pipe markers, extending 360° around pipe at each location, fastened by the following method:

a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2-inches.

3. Large Pipes: For external diameters of 6-inch and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three (3) times letter height (and of required length), fastened by one (1) of the following methods:

a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2-inches wide, full circle at both ends of pipe marker, tape lapped 3-inches.

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

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

C. Plastic Tape:

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

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

3. Color: Comply with ANSI A13.1, or as scheduled below:

ITEM	BAND COLOR
Fire Protection	Red
Heating Water	Yellow
Refrigerant Liquid and Suction, Chilled Water	Green
Crac Unit water system	Green

2.11 VIBRATION CONTROL

A. Flexible Pipe Connectors: Provide neoprene or EDPM construction consisting of multiple plies of nylon tire cord fabric and elastomer molded and cured in hydraulic rubber presses. Provide straight or elbow connector as indicated, rated at 125 PSI at 220°F.

2.12 ACCESS PANELS

A. All panels shall be MILCOR, Style "M" for masonry, Style A for acoustical tile, and Style K for plaster; except that Fire Rated UL 1-1/2 hour and "B" label access panels shall be furnished in fire-rated walls and ceilings as indicated on the Drawings.

B. Access doors shall be 12-inch x 12-inch minimum size for valves and water hammer arrestors and shall be 24-inch x 36-inch for access to equipment and filters.

2.13 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000 PSI (34.50 MPa), 28 day compressive strength.

3. Packaging: Premixed and factory-packaged.

2.14 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One-part, non-acid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.

2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and non-porous joint substrates; formulated with fungicide; intended for sealing interior joints with non-porous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.

3. Products: Subject to compliance with requirements, provide the following:

a. One-Part, Non-acid-Curing, Silicone Sealant:

(1) "Dow Corning 790," Dow Corning Corp. (or Equal)

b. One-Part, Mildew-Resistant, Silicone Sealant:

(1) "Dow Corning 786," Dow Corning Corp. (or Equal)

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5%.

1. Products: Subject to compliance with requirements, provide the following:

a. "Chem-Calk 600," Bostic Construction Products Div. (or Equal)

E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistant ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide the following:

a. "Dow Corning Fire Stop Foam," Dow Corning Corp. (or Equal)

PART 3 - EXECUTION

3.1 PIPING SYSTEMS-COMMON REQUIREMENTS

A. General: Install piping as described below, except where system Sections specify otherwise.

B. General Locations and Arrangements: Drawings (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, except where deviations to layout are approved on coordination drawings.

C. Install piping at indicated slope.

D. Install components having pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

H. 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.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

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

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

L. Install couplings according to manufacturer's printed instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.

2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.

3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.

4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.

5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.

N. Sleeves are not required for core drilled holes.

O. Permanent sleeves are not required for holes formed by PE plastic (removable) sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.

1. Cut sleeves to length for mounting flush with both surfaces.

   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2-inches (50mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.

2. Build sleeves into new walls and slabs as work progresses.

3. Install large enough sleeves to provide 1/4-inch (6mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than 6-inches.

   b. Steel Sheet-Metal Sleeves: For pipes 6-inches and larger that penetrate gypsum-board partitions.

   c. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2-inches (50mm) above finished floor level.

4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.

Q. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch (25mm) annular clear space between pipe and sleeve for installation of mechanical seals.

1. Install steel pipe for sleeves smaller than 6-inch.
2. Install cast-iron wall pipes for sleeves 6-inch and larger.
3. Assemble and install mechanical seals according to manufacturer's printed instructions.

R. Below Grade, Exterior Wall, Pipe Penetrations: Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch (25mm) annular clear space between pipe and sleeve for installation of mechanical seals.

S. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material.

T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system 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 "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."

4. 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 inside diameter. Join pipe fittings and valves as follows:

a. Note the 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 (except where 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 having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

5. 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 the "Quality Assurance" Article.

6. 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.

U. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

1. Install unions in piping 2-inch (50mm) and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch (50mm) or smaller threaded pipe connection.

2. Install flanges in piping 2-1/2-inches (65mm) and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

3. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

4. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.

5. Install isolation valves upstream of all dielectric unions and flanges.

3.2 EQUIPMENT INSTALLATION-COMMON REQUIREMENTS

A. Install equipment to provide the maximum possible headroom where 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 the Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 VALVE SELECTION

A. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size 2-Inch and Smaller: Solder ends, except in heating hot water and low pressure steam service which shall have threaded ends.

2. Steel Pipe Sizes 2-Inch and Smaller: threaded or grooved-end.

3. Steel Pipe Sizes 2-1/2-Inch and Larger: grooved-end or flanged.

3.4 VALVE INSTALLATIONS

A. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.

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

C. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices.

D. Install 3-valve bypass around each pressure reducing valve using throttling type valves.

E. Install valves in horizontal piping with stem at or above the center of the pipe, and to allow full stem movement.

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

1. Swing Check Valves: Install in horizontal position with hinge pin level.
2. Wafer Check Valves: Install between two (2) flanges in horizontal or vertical position.
3. Lift Check Valve: Install in piping line with stem upright and plumb.

G. Valve Schedule:

1. Sectional Valves:

a. 2-inch and Smaller: Ball valves.
b. 2-1/2-inch and Larger: Gate or butterfly valves.

2. Shut-off Valves:

a. 2-inch and Smaller: Ball valves.
b. 2-1/2-inch and Larger: Gate or butterfly valves.

3. Throttling Valves:

a. 2-inch and Smaller: Ball or globe valves.
b. 2-inch and Larger: Globe or butterfly valves.

H. Valve Locations:

1. HVAC Hydronic Piping:

a. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves two (2) or more hydronic terminals or equipment connections, and elsewhere as indicated.

b. Shut-off Valves: Install on inlet and outlet of each mechanical equipment item, and on inlet of each hydronic terminal, and elsewhere as indicated.

c. Throttling Valves: As required on plans.

2. Valve Tags:

a. Provide valve tags for all valves and list on Valve Schedule.

b. Install tags on valves in piping systems, except check valves, valves within factory-fabricated equipment units; plumbing fixture supply stops; and HVAC terminal devices.

3.5 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

	VALVES 2-INCHES AND SMALLER			
SERVICE	GATE	GLOBE	BALL	CHECK
Chilled Water	125	150	150	125
Heating Hot Water	150	150	150	150
CRAC Unit Water	150	150	150	150

	VALVES 2-1/2-INCHES AND LARGER			
SERVICE	GATE	GLOBE	BUTTERFLY	CHECK
Chilled Water	125	125	200	125
Heating Hot Water	125	125	200	125
CRAC Unit Water	125	125	200	125

3.6 PIPING SPECIALTIES INSTALLATION

A. Y-Type Strainers: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shut-off valve in strainer blow-down connection, full size of connection, except for strainers 2-inch and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shut-off valve to plumbing drain, full size of blow-down connection.

1. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment:

a. Pumps.
b. Temperature control valves.
c. Pressure reducing valves.
d. Temperature or pressure regulating valves.

3.7 METERS AND GAUGES INSTALLATION

A. Glass Thermometers:

1. General: Install glass thermometers in vertical upright position, and tilted so as to be easily read by observer standing on floor.

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

a. At inlet and outlet of each hydronic zone.

b. At inlet and outlet of each hydronic boiler and chiller.

c. At inlet and outlet of each hydronic coil in air handling units, and built-up central systems.

3. Thermometer Wells: Install in piping at each thermometer and temperature control sensing device in vertical upright position. Fill well with oil or graphite, secure cap.

B. Pressure Gauges:

1. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.

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

a. Across suction and discharge of each hydronic pump.

b. At discharge of each pressure reducing valve.

c. Across inlet and outlet of each hydronics coil of air handling units and built-up central systems.

d. Across inlet and outlet of each heat exchanger, water chiller, evaporator, etc.

3.8 SUPPORTS AND ANCHORS INSTALLATION

A. Hangers and Supports:

1. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping. Piping shall not be supported from bottom cord of bar joist or from metal roof deck, unless approved by Structural Engineer. Piping may be supported at panel points of bar joists.

2. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

3. Powder-actuated fasteners shall be approved only for installation where load will be applied perpendicular to the fasteners. Powder-actuated fasteners shall not be used where load will be applied to axially to the fasteners.

4. Support fire-water piping independently of other piping.

5. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

B. Saddles and Shields:

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

a. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8-inch and over, install wood insulation saddles.

b. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.9 MECHANICAL IDENTIFICATION INSTALLATION

A. Install equipment markers with permanent adhesive or appropriate fasteners on or near each major item of mechanical equipment

1. Locate markers where accessible and visible.
2. Include markers for the following categories or equipment:

a. Main control and operating valves.

b. Fire Department hose valves, hose stations and risers.

c. Boilers, pumps, compressors, chillers, condensers, cooling towers, heat exchangers, energy recovery units, fans, central station and zone-type units, heat pumps, tanks, pressure vessels, humidifiers, water-treatment systems, and similar equipment.

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

1. Near each valve and control device.

2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

4. At access doors, manholes and similar access points which permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced intermediately at maximum spacing of 50-feet along each piping run, except reduce spacing to 25-feet in congested areas of piping and equipment.

7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.10 VIBRATION CONTROL INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration control materials and units. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

B. Flexible Pipe Connectors: Install on equipment side of shut-off valves, horizontally and parallel to equipment shafts wherever possible.

3.11 ACCESS PANEL INSTALLATION

A. Mechanical Contractor shall locate and furnish for installation by General Contractor, all access panels as required for access to valves and water hammer arresters, dampers, and the proper servicing of equipment and piping installed under this Contract.

3.12 CONCRETE BASES

A. Construct concrete equipment bases of dimensions indicated, but not less than 4-inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000 PSI, 28 day compressive strength concrete and reinforcement.

3.13 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."

3.14 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.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.15 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned mechanical materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing mechanical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage by Owner.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. Mechanical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete piping, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.

a. Piping and ducts embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.

3.16 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.17 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 printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

3.18 PIPING TEST

A. No piping work, fixtures, or equipment shall be concealed or covered until they have been observed by the Engineer's representative, who shall be notified by the Contractor when the work is ready for inspection. All work shall be completely installed, tested as required by this Section and the State Ordinances and State Safety Orders, and shall be leak-tight before inspection is requested. All tests shall be repeated upon request to the satisfaction of those making the inspection.

B. Piping tests shall be made with the test medium and under test pressures listed in the following table. Use a calibrated Bristol Pressure Recorder, or equal, on all tests. Engineer's representative shall install and remove each chart. Recorder range shall be 0-300 pounds or required range for specific test.

PIPING TESTS

Type of Piping	Test Pressure	Test Medium	Test Period
Refrigeration and Fuel Suction	1st – 150 PSIG 2nd – 25 in. vacuum	Nitrogen	One Hour Each Test
Refrigeration Liquid and Hot Gas	1st – 300 PSIG 2nd – 25 in. vacuum	Nitrogen	One Hour Each Test
Heating Hot Water, Chilled Water, Crac Unit Water	50 PSIG or twice operating pressure, whichever is greater	Water	One Hour

C. Test pressure in lbs. per square inch, or inches of vacuum, gauge, are given as an initial pressure to be applied to lines being tested, together with test medium.

D. Final pressures at the end of test period shall be no more or less than that caused by expansion or contraction of the test medium due to temperature changes.

E. Check of systems during application of test pressures should include visual check for water medium leakage, soap bubble or similar for air and nitrogen medium, and halide torch for refrigerant medium after charging.

F. During heating and cooling cycles, linear expansion shall be checked at all elbows, U-bends, expansion joints, etc., for proper clearance.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of testing, adjusting and balancing work required by this section is indicated on drawings and schedules, and by requirements of this section; and is defined to include, but is not necessarily limited to, air distribution systems, hydronic distribution systems, and associated equipment and apparatus of mechanical work. The work consists of setting speed and volume (flow) adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required by Contract Documents.

B. Component types of testing, adjusting and balancing specified in this section includes the following as applied to mechanical equipment:

1. Air Distribution Systems

a. Air handling units.
b. Air-conditioning units.
c. Fans.
d. Ductwork systems.
e. Terminal units.
f. Diffuser, registers and grilles.
g. Coils.

2. Hydronic Systems

a. Coils.
b. Hydronic zones.
c. Piping systems.

1.2 QUALITY ASSURANCE

A. Tester's Qualifications: Firm certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines similar to those required for this Project and may also be the original Installer of system to be tested.

B. Codes and Standards:

1. NEBB Compliance: Comply with NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" as applicable to mechanical air hydronic distribution systems and associated equipment and apparatus.

2. Industry Standards: Comply with ASHRAE recommendations pertaining to measurements, instruments, and testing, adjusting and balancing, except as otherwise indicated.

1.3 SUBMITTALS

A. Submit certified test reports signed by Test and Balance Supervisor who performed TAB work. In addition, have report certified by Professional Engineer who is familiar with TAB work and also with Project, and who is registered in jurisdiction where testing is being conducted.

B. Include identification and types of instruments used, and their most recent calibration date with submission of final test report.

C. Submit biographical data on Engineer who is to directly supervise testing, adjusting and balancing work.

D. Maintenance Data: Include in maintenance manuals, copies of certified test reports, identification of instruments and data on Engineer.

1.4 JOB CONDITIONS

A. Do not proceed with testing, adjusting, and balancing work until work has been completed and is operable. Ensure that there is not latent residual work still to be completed.

B. Do not proceed until work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt and discarded building materials.

PART 2 - PRODUCTS

2.1 ACCEPTABLE VENDORS

A. Vendors: Subject to compliance with requirements, provide testing, adjusting and balancing work by one (1) of the following:

1. Air & Fluid Management, Wilbur, NE.
2. Balancing Professionals, Inc., Sioux Fall, SD.
3. Balcon, Omaha, NE.
4. Systems Management and Balancing, Inc., Des Moines, IA.
5. Test and Balance Systems, Tea, SD.
1. Technical Enterprises, Inc.

2.2 PATCHING MATERIALS

A. Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs and similar purposes.

1. At Tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

2.3 TEST INSTRUMENTS

A. Utilize test instruments and equipment for TAB work required, of type, precision, and capacity as recommended in the following TAB Standards:

1. NEBB's Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Do not proceed with TAB work until unsatisfactory conditions have been corrected in a manner acceptable to Tester.

3.2 GENERAL TESTING, ADJUSTING, AND BALANCING

A. Test, adjust and balance environmental systems and components, as indicated in accordance with procedures outlined in applicable standards.

3.3 AIR SYSTEM TESTING, ADJUSTING AND BALANCING

A. Test, adjust and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards, with the following minimum requirements.

B. Make the following test, adjustments and recordings:

1. Test and adjust supply, return and exhaust fans. Adjust rotation and RPM to design requirements.

2. Test and record terminal voltages after above adjustments.

3. Test and record fan motor full load amperes after above adjustments.

4. Make Pitot Tube Traverse at main supply, return and exhaust ducts. Obtain design CFM at fans.

5. Test and adjust system static pressures; suction and discharge.

6. Test and adjust each diffuser, grille, and register to within 10% of design requirements. Adjust to minimize drafts in all areas. Readings and tests shall include required FPM velocity and test resultant FPM velocity, required CFM and test resultant CFM after adjustments.

7. Adjust automatically operated dampers to operate as specified, indicated, and/or noted. The testing agency shall check controls for proper calibrations and list the controls requiring adjustments by Control Installers.

8. Change pulleys, belts, and dampers, or add dampers as required for correct balance, as recommended by the Air Balancing Agency, at no additional cost to the Owner.

3.4 WATER SYSTEM TESTING, ADJUSTING AND BALANCING

A. Test, adjust and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards, with the following minimum requirements.

B. Preliminary checks, settings and adjustments shall be as follows:

1. Check pump rotation.

2. Check expansion tanks to determine that they are not air bound and the system is completely full of water.

3. Check air vents at high points of water systems and determine that all are installed and operating freely.

C. Phase I - Water systems testing and balancing procedures shall be as follows:

1. Set chilled water, hot water, and condenser water pumps to the proper gallon per minute delivery.

2. Proceed to balance each radiation zone and hot water coil.

3. Mark settings on valves and record data upon the completion of flow readings and adjustments at coils.

D. Phase II - Water systems testing and balancing procedures shall be as follows:

1. Recheck settings at the pumps and re-adjust, if required, after adjustments are made to each radiation zone and coil.

2. Check and record the following items at each cooling and heating element:

a. Inlet water temperatures.
b. Leaving water temperatures.
c. Pressure drop of each coil.
d. GPM at each pump, coil, and radiation zone.
e. Pump operating suction and discharge pressure and final total dynamic head.
f. List mechanical specifications of pumps.
g. Rated and actual running amperage of pump motor.
h. Check control valves for operation from full open to full closed.

3.5 SEASONAL CONSIDERATIONS

A. Test, adjust and balance system during summer season for air conditioning systems and during winter season for heating systems, including at least period of operation at outside conditions within 5°F wet bulb temperature of maximum summer design condition, and within 10°F dry bulb temperature of minimum winter design condition. When seasonal operation does not permit measuring final temperatures, then take final temperature readings when seasonal operation does permit.

3.6 CLOSEOUT PROCEDURES

A. Prepare report of test results, including instrumentation calibration reports, in format recommended by applicable standards.

B. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommended by original Installer.

C. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

D. Prepare a report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced; including, where necessary, modifications which exceed requirements of Contract Documents for mechanical work.

E. Retest, adjust and balance systems subsequent to significant system modifications and resubmit test results.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.1 GENERAL

A. HVAC insulation required by this section is indicated on drawings, and by requirements of this section.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation.

B. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each HVAC system requiring insulation.

1.3 QUALITY ASSURANCE

A. Furnish insulation and materials bearing the manufacturer's label. Only mechanics skilled at such work shall apply materials. Insulation and materials shall be by one of the manufacturers listed. Specialty material shall be of the manufacturer indicated or approved equal. Fire and smoke hazard classification ratings on insulation, jacket, and adhesive shall conform to NFPA 255, ASTM E 84, or UL-723 as follows:

1. Flame Spread Index not exceeding 25.
2. Fuel Contributed not exceeding 50.
3. Smoke Developed Index not exceeding 50.

B. Certifications: Submit certifications or other data as necessary to show compliance with these specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

C. Manufacturers: Firms regularly engaged in manufacture of HVAC insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

D. Subject to compliance with requirements, provide products of one (1) of the following manufacturers:

1. Armacell LLC
2. Dow Chemical Company
3. Einsulation, Inc.
4. Johns-Manville Corp.
5. Keene Corp.
6. Knauf Fiber Glass
7. Owens-Corning Fiberglass Corp.
8. Rubatex Corp.
9. Pittsburg Corning Corp.

E. Thermal Conductivity Average Maximum in Btu-in/hr-ft^2 at 75°F Mean Temperature:

1. Fiberglass Board = 0.26.
2. Fiberglass Blanket = 0.30.
3. Fiberglass Preformed Pipe Insulation = 0.26.
4. Cellular Glass = 0.30.
5. Flexible Elastomeric Cellular = 0.27.
6. Polyisocyanurate = 0.19.
7. Calcium Silicate = 0.60 @ 500°F.

F. Vapor retarder film and tape shall have a maximum permeance of 0.030 perm.

PART 2 - PRODUCTS

2.1 PIPING SYSTEM INSULATION

A. Piping insulation shall be as scheduled below:

	SYSTEM	PIPE SIZE AND LOCATION	INSULATION AND JACKET
1.	Air Conditioning Coil Condensate Drain Piping	All above ground piping	1-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket.
2.	Hot Water Heating Supply and Return Piping (Systems up to 200 °F)	Piping in building through 3-inch	1-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket.
3.	Hot Water Heating Supply and Return Piping (Systems up to 200 °F)	Piping in building 4-inch and larger	1-1/2–inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket.
4.	Refrigerant Suction Piping	Piping in building 1-inch and Less	1-inch 4-pcf density fiberglass insulation with fire-resistive ASJ vapor barrier jacket or 3/4-inch fire retardant flexible elastomeric closed-cell plastic foam.
5.	Refrigerant Suction Piping	Piping in building 1-1/4-inch and larger	1-1/2-inch 4-pcf density fiberglass insulation with fire-resistive ASJ vapor barrier jacket with weather-resistant coating or 1-inch fire retardant flexible elastomeric closed-cell plastic foam insulation.
6.	Refrigerant Suction Piping	Piping outside of building	Same as inside piping but with Weather-resistant coating.
7.	Chilled Water, and Crac UnitSupply and Return Piping	Piping in building through 1-1/4-inch	1/2-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket.

	SYSTEM	PIPE SIZE AND LOCATION	INSULATION AND JACKET
8.	Chilled Water, and Crac Unit Supply and Return Piping	Piping in building 1-1/2-inch and larger	1-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket.
9.	Chilled Water, and Crac Unit Supply and Return Piping	Piping outside of building	Same as inside piping but with Weather-resistant coating.

B. All pre-formed fiberglass and elastomeric closed-cell plastic foam pipe insulation shall be provided with self-adhering and self-sealing overlapping flap.

C. Insulation of Piping Specialties on Cold Piping Services: Insulate unions, flanges, strainers, flexible connections, hoses, and expansion joints on cold piping services with flexible elastomeric cellular insulation. Thickness of elastomeric cellular insulation shall be equivalent to thickness of insulation on the piping service as specified in this Section or as shown on the drawings. Insulation shall be sealed to provide a vapor tight barrier. Cold piping services include chilled water systems, and geothermal heat pump water loop systems.

D. Piping Insulation Omitted:

1. Insulation Omitted HVAC Systems: Omit insulation on hot piping within radiation enclosures or unit cabinets; on heating piping beyond control valve, located within 2-feet of coil and within heated space; on condensate piping between steam trap and union; and on unions, flanges, strainers, flexible connections and expansion joints on hot piping systems.

E. Insulation Protection:

1. Pipe insulation exposed in finished areas shall be protected with 0.030 inches thick ABS plastic jacketing covers, Ceel-Co 100 Series or approved equal.

2. Pipe insulation exposed in equipment rooms, indoor parking garages and other unfinished areas shall be protected with 0.030 inches thick, ultraviolet resistant, PVC plastic jacketing covers, Ceel-Co 300 Series or approved equal.

3. Pipe insulation exposed to weather or abuse shall be protected with a factory-fabricated aluminum jacket, 0.032-inch thick. Moisture barrier membrane for insulation exposed to weather shall be 3-mil thick polyethylene and kraft paper, installed according to manufacturer's recommendations for the application at hand.

2.2 DUCT INSULATION

A. Duct insulation shall be as scheduled on the drawings and as follows:

	SYSTEM	INSULATION
1.	Low Velocity Unlined Supply Ducts (Duct velocities below 2000 fpm)	1-1/2-inch fiberglass flexible insulation, 1.5-pcf density, with heavy duty FSK vapor barrier. Apply insulation with edges tightly butted secure on 15-inch centers with approved adhesive and pins. Secure joints by overlapping facing or 4-inch wide strips of same material adhered with Benjamin Foster 85-20 adhesive.

	SYSTEM	INSULATION
2.	High Velocity Supply Air Heating and Cooling Ducts (Duct velocities above 2000 fpm)	2-inch fiberglass flexible insulation, 1.5-pcf density with heavy duty FSK vapor barrier. Apply insulation with edges tightly butted. Secure on 15-inch centers with approved adhesive and pins. Secure joints by overlapping facing or 4-inch wide strips of same material adhered with Benjamin Foster 85-20 adhesive.
3.	Outside Air Ductwork	1-1/2-inch fiberglass rigid insulation, 3-pcf density with heavy duty FSK vapor barrier. Apply insulation with edges tightly butted. Secure on 15-inch centers with approved adhesive and pins. Secure joints by overlapping facing or 4-inch wide strips of same material adhered with Benjamin Foster 85-20 adhesive.
4.	Ventilation Air Ductwork	1-1/2-inch fiberglass flexible insulation, 1.5-pcf density, with heavy duty FSK vapor barrier. Apply insulation with edges tightly butted secure on 15-inch centers with approved adhesive and pins. Secure joints by overlapping facing or 4-inch wide strips of same material adhered with Benjamin Foster 85-20 adhesive.
5.	Supply Plenums, Relief Air, and Mixed Air Ducts in Equipment Rooms	1-1/2-inch fiberglass rigid insulation, 3-pcf density with heavy duty FSK vapor barrier. Apply insulation with edges tightly butted. Secure on 15-inch centers with approved adhesive and pins. Secure joints by overlapping facing or 4-inch wide strips of same material adhered with Benjamin Foster 85-20 adhesive.
6.	Supply Ductwork off VAV and Dual Duct Terminal Units	1-1/2-inch fiberglass flexible insulation, 1-1/2-pcf density, with heavy duty FSK vapor barrier. Apply insulation with edges tightly butted secure on 15-inch centers with approved adhesive and pins. Secure joints by overlapping facing or 4-inch wide strips of same material adhered with Benjamin Foster 85-20 adhesive.
7.	VAV Terminal Units Reheat Coils	Same as low velocity unlined supply ducts.
8.	Exhaust Ductwork from Building Roof or Wall to 10 feet inside of building	1-1/2-inch fiberglass flexible insulation, 2-pcf density with heavy duty FSK vapor barrier. Apply insulation with edges tightly butted. Secure on 15-inch centers with approved adhesive and pins. Secure joints by overlapping facing or 4-inch wide strips of same material adhered with Benjamin Foster 85-20 adhesive.
9.	Flexible Duct Connections	Same as low velocity unlined ductwork.

B. Ductwork Exposed to Weather: 2-inch thick, 4-pcf density spun fiberglass rigid insulation board with FSK facing. Adhere insulation board to the duct with asphalt mastic and metal clips. Cover insulation board with a pre-fabricated self-adhering and self-sealing sheet type waterproof membrane. Adhere the waterproof membrane to insulation according to manufacturer's recommendation for the application at hand. The waterproof membrane shall be Flex-Clad 400 as manufactured by MFM Building Products Corporation of Coshocton, OH or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with the MICA National Commercial and Industrial Insulation Standards to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to testing and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. The appearance of the completed insulation shall be a significant factor in determining the acceptability of the work.

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

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

F. Where vapor retarders are specified, elbows and fittings shall be wrapped with vapor retarder tape 3-inches wide or shall have PVC jacketing.

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

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

I. Insulated piping systems shall be supported on the exterior of the insulation surface. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

J. Metal shields: Conform to table below for minimum length of shield:

PIPE SIZE	INSULATION THICKNESS	LENGTH OF SHIELD
Less than 1″	Up to 1″	3″
1″ – 2″	1″	4 1/2″
1″ – 2″	1 1/2″	5 1/2″
2 1/2″ – 4″	1″	6 1/2″
2 1/2″ – 4″	1 1/2″	7 1/2″
2 1/2″ – 4″	2″	8 1/2″
2 1/2″ – 4″	2 1/2″	9 1/2″
5″ and Larger	1″	13″
5″ and Larger	1 1/2″	14″
5″ and Larger	2″	15″
5″ and Larger	2 1/2″	16″
5″ and Larger	3″ and Larger	18″

K. Pipe Hanger, Trapeze, and Roller Support Insulation Inserts: Butt pipe insulation against pipe hanger insulation inserts. Apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3-inch wide vapor barrier tape or band.

3.2 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with the MICA National Commercial and Industrial Insulation Standards to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

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

D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

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

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.

G. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

H. Flexible Duct Connections: Install insulation materials on flexible duct connections wherever ductwork connects to vibration isolated equipment. Provide adequate flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

3.3 PROTECTION AND REPLACEMENT

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

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

END OF SECTION

SECTION 23 09 00

ELECTRONIC CONTROL SYSTEMS AND FACILITIES MANAGEMENT SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide a Building Management and Control System (BMCS) incorporating Direct Digital Control (DDC), equipment monitoring, and temperature control consisting of a Honeywell XL-800 building controller with a Liquid Crystal Display, with data displays; microcomputer based Building Management Controllers (BMCs) and Unitary DDC Controllers (UCs) interfacing directly with sensors, actuators and environmental delivery systems (i.e., HVAC units, boilers, chillers, lighting systems, terminal equipment control devices, etc.); controls and mechanical devices for all items indicated on drawings described herein including dampers, valves, panels; a primary high-speed peer-to-peer communication network to allow data exchange between all controllers. The system shall be based on the industry standard LonWorks protocol as manufactured by Honeywell Controls. Contact Brent Wical, Honeywell, 1335 2nd Ave N, Fargo, ND 58102, 1-701-297-6266. The new electronic temperature control system shall be compatible and connected to the anticipated Grand Forks AFB base-wide Honeywell EBI system. Included with this new DDC control work, the temperature control contractor shall provide any systems software configurations, trend logging of the variables, programming of energy management functions, provide time of day scheduling, and any programming associated with the EBI system to bring this project on board with the intended EBI base wide system. This work would include getting the TCP/IP network to the building for connection to the EBI system.

B. Submittals, programming, data entry, electrical installation, start up, test and validation acceptance documentation, and system warranty.

C. Complete temperature control system to be DDC with electronic sensors and electric/electronic actuation of valves and dampers.

D. The system shall include all interconnecting wiring and conduit as required for a fully operational system as specified. Wiring shall be installed as per local codes or Division 16 whichever is more stringent, and a letter indicating method of code compliance which shall be furnished with first shop drawing submittal.

1. Line voltage wiring shall utilize methods and materials complying with the requirements of the Electrical Specifications (Section 16000 for Light and Power Circuitry), local building code, and NEC.

2. Low voltage wiring shall use methods and materials complying with the requirements of the Electrical Specifications (Section 16000) for Circuitry for Miscellaneous Low Voltage Systems, local building code and NEC.

1.2 WORK BY OTHERS

A. Access doors and setting in place of valves, flow meters, water pressure and differential taps, flow switches, thermal wells, dampers, air flow stations, and current transformers.

B. Codes and Approvals:

1. The complete BMCS installation shall be in strict compliance to the national, state and local mechanical and electrical codes and the electrical section of these specifications. All devices shall be UL or FM listed and labeled for the specific use, application and environment to which they are applied.

2. The system shall comply with NFPA 90A Air Conditioning and 90B Warm Air Heating, Air conditioning.

3. System shall be designed and manufactured to ISO 9001 quality standard, and all electronic equipment shall conform to the requirements of FCC regulation Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled and European CE rating for electromagnetic emissions standards.

4. The unitary controllers, intelligent sensors, and intelligent actuators shall be based upon LonMark functional profile configurations.

1.3 WARRANTY

A. All components, system software, and parts supplied by the BMCS contractor shall be guaranteed against defects in materials and workmanship for one year from acceptance date. Labor to repair, reprogram, or replace components shall be furnished by the BMCS contractor at no charge during the warranty period. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the Owners request for warranty service within 24 hours during normal business hours.

PART 2 PRODUCTS

2.1 BMCS HARDWARE

A. Workstation Hardware. Provide a new personal computer for the Owner to get access to the temperature control system and have the ability to change operating parameters, and monitor the operation of the mechanical systems serving this facility. The personal computer shall be located in room 216, Office.

B. Building Manager Controller (BMC) shall be standalone controller configured to perform the sequences specified, and with I/O selected for the application. BMCs shall be tested and listed under UL916 for Energy Management computing devices. Each BMC shall be provided with a face mounted LED type annunciation to continually display its operational mode: power, normal, or in an alarm state. A LonTalk Bus operator interface connection shall be provided using a Serial LonTalk Adapter. The following Inputs/Outputs shall be provided:

1. Four dry contact digital inputs.
2. Eight 0-10V, 0-10,000 ohm (20K NTC) analog inputs.
3. Two 4-20 mA analog outputs.
4. Eight 24 Vac Triac digital outputs.
5. One 21 Vdc, 70-mA power supply for auxiliary devices.

C. BMC communications shall utilize a Free Topology Transceiver (FTT) to support polarity-insensitive free topology wiring scheme for star, loop and/or bus wiring. The BMC shall support 60 nodes per segment. Each BMC shall support 20 UCs and three remote I/O

controllers with a total of up to twenty devices with alarm capabilities. A single network shall support a minimum of four BMCs.

D. BMC shall support the following building management features:

1. Real time clock with automatic daylight savings adjustment.

2. Time of day schedules for up to 20 UCs. Eight schedules each with seven weekdays, three special days and one temporary day schedule. Each schedule shall be capable of six mode changes per day between occupied, standby, and unoccupied.

3. Alarm Management software to provide prioritization, routing, remote dialing, and history logging.

4. Trending and logging of energy, alarms, bypass usage, and runtime.

5. Remote equipment monitoring and control with dial-out on critical alarm and full buffer.

E. BMC shall support the following control techniques:

1. Six configurable control loops that can incorporate Demand Limit Control strategies, Setpoint reset, adaptive intelligent recovery, and time of day bypass.
2. General purpose PID loops.
3. Standard thermostat control loops.
4. Heat pump control loops.
5. Start/Stop loops.
6. Demand Limit Control.

F. AHU/Central Plant controllers (AHU/CP) shall be configurable to meet the specific application. All control sequences within or programmed into the AHU/CPs shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

1. HVAC control shall be accomplished using LonMark™ based devices where the application has a LonMark profile defined. If a functional profile is not defined for a particular device it shall at a minimum employ LonMark™ network variables for communication via the network. All programming, documentation and programming tools necessary to set up and configure the supplied devices per the specified sequences of operation shall be provided.

2. The AHU/CPs shall communicate with the BMS at a baud rate of not less than 78.8K baud. The AHU/CP shall provide LED indication of communication and controller performance to the technician, without cover removal.

3. The AHU/CPs shall be operational as configured to perform the sequences specified, and with I/O selected for the application. Controllers shall be tested and listed under UL916 for Energy Management computing devices. Each controller shall be provided with a face mounted LED type annunciation to continually display its operational mode: power, normal, or in an alarm state. The following integral Inputs/Outputs shall be supported per each AHU/CP:

a. Eight integral dry contact digital inputs.

1) Any two digital inputs may be configured as pulse counters with a maximum pulse read rate of 15 Hz.

b. Eight integral analog inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC).

c. Six integral 0-20 ma analog outputs.

d. Eight integral 24 Vac Triac digital outputs, configurable as maintained, or floating motor control outputs.

e. One integral 20 Vdc, 65-mA power supply for auxiliary devices.

f. If a 20 Vdc 65-mA power supply terminal is not integral to the AHU/CP, provide at each AHU/CP a separate, full isolated, enclosed, current limited and regulated UL listed auxiliary power supply for power to auxiliary devices

4. Each AHU/CP shall have expansion ability to support additional I/O requirements through the use of remote input/output modules via the LonWorks™ network. The minimum remote expansion capability per AHU/CP shall be:

a. Twenty remote four digital outputs.

b. Twelve remote digital inputs.

c. Eighteen remote analog inputs.

d. Remote I/O shall operate via direct peer-peer communication between the AHU/CP and the remote I/O modules. No additional hardware or software shall be required to fully utilize remote I/O modules. AHU/CP algorithms shall be able utilize remote I/O data points equivalent to integral I/O points.

5. AHU/CP Controllers shall support the following control techniques:

a. Ten configurable general-purpose control loops that can incorporate Demand Limit Control strategies, Setpoint reset and setpoint override, adaptive intelligent recovery, and time of day bypass. Control loops shall be capable of providing modulating control or multiple staging of peripheral equipment using a single control loop.

b. Eight start/stop Loops.

c. Thirty-two "If/Then/Else" type logic loops.

d. Thirty six total Math Function loops

1) 30 Math functions of (MIN, MAX, AVG, SUM, SUB, ,SQRT, MUL, DIV, ENTHALPY).

2) 6 special Math functions of (Min, MAX, AVG) for network points.

6. The AHU/CPs shall be configured for DIN rail mounting using industry standard clip on adapters or direct panel mounted. Each controller shall be designed with on-board

jacks for quick commissioning and troubleshooting with a portable programming tool. This connection shall be extended to a space temperature port where indicated and shown on plans.

G. VAV Terminal Unit Controller

1. Provide a standalone DDC VAV terminal unit controller for factory mounting featuring preprogrammed heating and cooling control algorithms. Controller shall be designed to work with pressure independent units and pressure dependent units. Pressure independent units shall contain a default algorithm to revert to pressure dependent mode on failure of the flow sensor. Controller shall be configurable for the following options: No Fan, Series Fan, Parallel Fan, Three Stages of Reheat or Modulating, Peripheral Radiation Control, Dual Duct, Exhaust Tracking, Occupancy Sensor, Window Sensor, Shared or Direct Wired Wall Module. Controller shall use Echelon LonWorks communication technology for field bus and shall utilize the LonMark Variable Air Volume (VAV) communication profile for Interoperability with similar protocol third party devices in network applications. Controller application software shall include; set point reset for energy demand limit control or outdoor air compensation, optimum start, night purge and morning warm-up. A standby feature shall be provided to reset the occupied temperature set point back to a user definable limit based on status from an auxiliary device, such as an occupancy sensor or window contact. In addition to internal I/O selected for the application, controller shall also support distributed I/O from the network.

2. The control contractor shall furnish and ship damper actuators and Unitary DDC Controllers to the terminal equipment manufacturer for factory installation. See section 15851 and plans for coordination details. (Note: Terminal equipment manufacturer furnishes transformers, relays, airflow rings, and enclosures.) The control contractor shall provide the terminal equipment manufacturer with necessary wiring and mounting instructions. Any mounting charges shall be the responsibility of the equipment manufacturer.

3. VAV UCs shall have configured airflow calibration software for VAV applications to assist the test and balance (T&B) contractor in final calibrations. Using the UC contractor's calibration tool, the T&B contractor shall be provided with a display allowing a simple command entry to place the UC in zero, minimum, and maximum CFM control modes. At each mode, a display field shall be provided for the T&B contractor to enter the actual measured value in CFM. Upon completion of entering the three values, the UC shall automatically recalibrate based upon the actual values.

4. Unitary DDC Controllers (UCs) shall be standalone EEPROM based configured to perform the sequences specified, and with I/O selected for the application. All unitary DDC controllers shall support the LonMark Functional Profile for the given application. UCs shall be tested and listed under UL916 for computing devices. UC enclosures shall be flame retardant compact plastic conforming to UL94-V5 for plenum mounting or plated steel. Each UC shall be provided with face mounted LED type annunciation to continually display its operational mode: power, normal, or in an alarm state. As an alternative to the face mounted integral LED, the control contractor shall provide relay driven pilot lights mounted at the UC location which shall provide the specified annunciation. UCs shall be configured for DIN rail mounting using industry standard clip on adapters or direct panel mounted. Each controller shall be designed with on-board jacks for quick commissioning and troubleshooting with PC software. This connection shall be extended to a space temperature port where indicated and shown

on plans. 9600-baud UC networks shall be grouped with no more than 20 UCs per primary bus connected device, except for UC networks operating over 50K baud, up to 60 UCs may be so grouped.

5. Single Zone Constant Volume Air Handling Unit Controller/Heat Pump Controller

   a. Provide a stand alone Single Zone DDC Controller featuring preprogrammed heating and cooling and economizer control algorithms configurable for either standard single zone rooftop unit applications or heat pumps. Controller shall be LonMark certified for the Rooftop Unit Controller Application for interoperability with similar protocol third party devices in network applications. For rooftop applications, the controller shall have extended operating temperature rating from -40F to +150F so controller can be mounted directly in wiring cabinet of AHU. If controller provided does not have -40F to 150F temperature range, then the device shall be mounted in a separate enclosure with suitable heating and cooling to meet the controller operating temperature range. Controller application software shall include setpoint resets for energy demand limit control and economizer minimum position for IAQ control. Separate unoccupied heating and cooling setpoints shall be provided. A standby feature shall be provided to reset the occupied temperature set point back to a user definable limit based on status from an auxiliary device, such as an occupancy sensor or window contact. Controller shall include a temperature wall module connection that may be used in applications where the wall module must: sense temperature, control set point temperature and control Occ/Unocc condition. In addition to internal I/O selected for the application, controller shall also support distributed I/O from the network.

   b. The control contractor shall furnish and ship damper actuators (if required) and Unitary DDC Controllers to the heat pump equipment manufacturer for factory installation. See section 15851 and plans for coordination details. The control contractor shall provide the heat pump equipment manufacturer with necessary wiring and mounting instructions.

6. Input/Output Module

   a. Provide a remote input/output module that connects sensors and actuators onto the field bus network for use by the BMC and Unitary DDC Controllers. I/O Device shall support LonMark standard network communication technology for controller-to controller communications. I/O Device shall have extended operating temperature rating from -40F to +150F so Device can be mounted directly in wiring cabinet of monitored appliances.

2.2 BUILDING MANAGER CONTROLLER APPLICATION SOFTWARE

A. Control Software:

1. Start/Stop Control Loops. The start/stop control loops shall allow direct control of loads based on time-of-day schedules. Each start/stop loop can command digital outputs on the BMC or a remote point on the network.

2. Control Application Software shall be customized to meet the detailed requirements of the "Sequence of Operation". All BMC control software shall be designed via an icon based and ‘fill-in-the-blanks” configuration tool.

3. Proportional, Proportional-Plus-Integral (PI), and Proportional-Plus-Integral-Plus-Derivative (PID) algorithms shall be provided and implemented where specified.

4. Provide digital and analog logic operators including AND, OR, XOR, NOT, NAND, NOR, XNOR, MINIMUM, MAXIMUM, and AVERAGE.

5. Application specific standard thermostat loops and heat pump control loops shall be included.

B. Energy Management Software:

1. Adaptive Intelligent Recovery: Provide software to gradually increase or decrease occupant space temperature setpoint before the occupied periods to ensure it is comfortable at occupancy time and that energy use is minimized.

2. Demand Limit Control (DLC) program: Provide software to shed electrical loads to prevent exceeding an electrical demand peak value (target). The program shall continuously monitor power demand, and with prediction software, calculate a predicted power demand. When the predicted power demand exceeds a preset desired target, the program shall shutoff or adjust operation of electrical loads on a prescheduled priority basis to reduce the connected load before the actual peak exceeds the target. The DLC program shall provide several priority levels of loads. Loads in the lowest priority level shall be shed before loads in the next higher priority level. Loads shed within a priority level shall be rotated automatically, subject to equipment constraints to avoid any one load from always being shed first. Loads shed in the highest priority level shall be restored before loads in lower priority levels. The DLC program shall be compatible with time-of-day metering. The start and stop time of each time-of-day demand program shall allow different daily schedules for 3 types of days (weekday, weekend, and holiday). The program that shall define daily time-of-day metering schedules shall establish a time-of-day metering calendar. The DLC program shall be able to shed or reset the setpoint of any or all local control loops and additional loops in Unitary Controllers on the same bus. The DLC program shall allow for minimum and maximum shed times and minimum on times for each point. Each shed point can have an assigned sensor that shall override DLC if sensed conditions require a point to be restored.

3. Day-night setback program: Provide software to limit the rise or drop of space temperature during unoccupied hours. Whenever the space temperature is above (or below for heating) the operator assigned temperature limit, the system shall be enabled until the temperature is within the assigned temperature limit.

4. Network Time Master/Scheduler. The BMC shall act as a network time master with real time clock/calendar. Only one BMC shall act as the network time master and shall synchronize the time of day for all other network devices. Once the BMC is configured to enable daylight savings time no additional entries or commands shall be required to change enable or disable daylight savings time in subsequent years.

a. The BMC shall store and execute time schedules and shall act as the network time scheduler. The BMC shall issue current and next change of state (occupied, unoccupied, or standby) and time until next change of state to all

control loops. The scheduler shall also track exception/holiday schedules and monitor operating modes.

b. Reporting. The following logs shall be provided.

1) Alarm History Log. Alarm log shall be stored in capacitor backed RAM memory. The alarm log shall maintain the last 50 alarm events. Each alarm in the log shall include the date/time, source of alarm, and type of alarm.

2) TOD bypass log. The BMC shall log the TOD bypass for all control loops. TOD bypass in the log shall include the number of minutes in bypass for the current and previous month, and the most recent date/time of bypass.

3) Runtime log. The BMC shall support runtime logging for 15 digital inputs or outputs. Runtime resolution shall be +/- 10 minute per activation. Runtime data shall include the number of complete hours the input/output point has been active. User shall be able to manually clear each entry in the runtime log.

5. Trend log. The BMC shall support trending for up to 16 inputs. Each trend point shall include the following data: input point, sampling interval, type of trend, and starting date/time. Trend data shall be stored in capacitor backed RAM for a minimum of 6 hours in the event of a power loss. The following types of trends shall be supported.

a. One Shot Trend. One start time and one stop time.
b. Delta Trend. A change of state causes a point to trend.
c. Periodic Trend. Trend point is sampled at a periodic interval.

6. Energy History log. The BMC shall maintain an energy history log for up to 35 days. Trend data shall include the energy consumed (kWh), peak load (kW0, time of peak load, and degree days.

7. Alarms. The BMC shall monitor and report all control loops and up to 20 analog input points and specified digital points for off-normal conditions. Each alarm shall have user-defined pre-delay and post delay times. Each alarm shall be assigned one of five levels of alarm priority.

8. Alarm-Limits. For each analog alarm input, a maximum limit and a minimum limit shall be set for a particular value. Each time this limit value is reached an alarm shall be triggered.

9. Dial Out/Dial In. The BMC shall have the capability to dial out to a central workstation. This capability shall allow access to remote sites from a central system and provide remote alarm annunciation at a remote central workstation. Urgent alarms and a full buffer shall initiate dial out to central sites. The BMC shall dial out on a periodic basis to indicate normal operation. The BMC shall be configured to dial out to three phone numbers per time period with a total of three time periods per day.

10. Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on time and off time to be selected.

11. On/Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and set point. The algorithm shall be direct-acting or reverse-acting, and incorporate an adjustable differential

12. Calculated Point. Provide a program that will create an on-line pseudo-point as a result of a series of calculations. The calculations may use operator-entered constants, values of other points in the system, or values of other calculated points as variables in the equations. Provide the means for the calculated points to be used in loops for control purposes. Pseudo-points shall assume the same attributes as physical system points.

2.3 UNITARITY EQUIPMENT CONTROLLERS SOFTWARE

A. Unitary Controller (UC) Software shall be configured to meet the requirements of the "Sequence of Operation" specified and shall be field configurable. UC software shall support full PID control, and shall utilize separate PID gains for heating and cooling. Where UC space sensors are provided with temperature setpoint knobs, UCs shall be provided with unique software setpoint limits. Each UC shall have continuously running hardware diagnostics to detect malfunctions of the flow sensor where applicable, the temperature sensor, the remote setpoint sensor, and the A to D converter.

B. UCs shall have configured airflow calibration software for VAV applications to assist the test and balance (T&B) contractor in final calibrations. Using the UC contractors calibration tool, the T&B contractor shall be provided with a display allowing a simple command entry to place the UC in zero, minimum, and maximum CFM control modes. At each mode, a display field shall be provided for the T&B contractor to enter the actual measured value in CFM. Upon completion of entering the three values, the UC shall automatically recalibrate based upon the actual values.

2.4 VARIABLE FREQUENCY DRIVE (VFD) SOFTWARE

A. The Variable Frequency Drive (VFD) shall have seven programmable applications which can be modified using a personal computer based commissioning tool with an optional software package, or a control panel with either an alpha-numeric or graphic LCD.

1. Basic Application – Control I/O signals are fixed and limited parameters are available.

2. Standard Application – The same I/O signals and same control logic as Basic Application but with programmable options.
3. Local/Remote Application – The use of two different control and frequency sources is programmable.

4. Multi-step Speed Control Application – Used where fixed speed references are required.

5. PI Control Application – Uses internal PI control loop to control motor frequency.

6. Multi-purpose Control Application – The frequency reference can be selected from analog inputs, joystick control, motor potentiometer, or a mathematical function of the analog inputs.

7. Pump and Fan Control Application – Used to control one variable speed drive and up to 3 auxiliary drives.

2.5 CONFIGURATION SOFTWARE

A. Configuration Software Tool (CST). CST shall provide for configuration and commissioning of the BMC, CDM, UCs, and NPTs. CST shall allow operator to select and customize application-specific controllers, create a LonWorks network, customize data sharing between controllers on the network, and monitor system behavior.

1. CST shall communicate with controllers serially through the Serial LonTalk Adapter over a LonWorks digital data network. CST shall be connected directly to the network or remotely using modems.

2. CST shall provide for a drop and drag technique for building the control network graphically via icons on the screen. The operator shall then be able to configure controller options by clicking on the icon. The configuration screen shall be configured with standard defaults already defined.

3. CST shall provide for downloading and commissioning of controllers. Provide an on-line mode to monitor the complete network and an off-line mode for testing of individual controllers.

4. CST shall automatically configure data sharing among controllers on a network.

5. Provide reports for documenting the configuration of the network. These shall include device data, controller alarms, communications statistics, and project documentation.

6. Provide a context-sensitive on-line help utility on the detailed operation of the CST.

2.6 DATA COMMUNICATIONS

A. The communications network shall be based on industry standard LonWorks open protocol

1. All communications shall be via twisted pairs wires, shielded where required and approved for use with LonWorks Free Topology Transceivers.

2. UCs and intelligent actuators and sensors shall reside directly on a peer-to-peer network utilizing LonMark configurations with selectable speed from 78K Baud up to 1 megabit. Bus speed shall be selected to maintain the required system response times. Physical media configurations shall be provided to support the LonWorks protocol.

2.7 ELECTRIC AND MECHANICAL AND DEVICES

A. All electric switch devices shall be selected for the applied load and UL listed and labeled for the application and environment to which they are applied. Miscellaneous, electric, pneumatic, and mechanical devices shall include:

1. Airflow measuring stations required to accomplish the specified control sequence shall be furnished under this section but installed under the sheet metal section. Airflow measuring stations shall be of heavy gauge metal construction, and shall be furnished with an air straightening section with an open face area of not less than 97%.

a. Provide on supply fan SF-1, exhaust fan EF-1, and exhaust fan EF-2 airflow traverse probes mounted in the fan inlets capable of continuously measuring the air handling unit airflow rate of the respective fans.

1) The fan inlet airflow traverse probes shall contain multiple total and static pressure sensors placed at concentric area centers along the exterior surface of the cylindrical probes and internally connected to their respective averaging manifolds.

2) The fan inlet airflow traverse probes shall have symmetrical averaging signal takeoffs, and shall be of aluminum construction with hard anodized finish with galvanized steel mounting hardware.

3) The probes shall be capable of producing steady, non-pulsating signals of standard total and static pressure, without need for flow corrections or factors, with an accuracy of 3% of actual flow over a fan operating range of 6 to 1 capacity turndown.

4) The fan inlet airflow traverse probes shall be the the Volu-probe/FI as manufacturer by Air Monitor Corporation or approved equal.

2. Any automatic control dampers not specified to be integral with other equipment. Frames shall not be less than 13-gauge galvanized steel. Blades shall not be over 8 inches wide nor less than 16-gauge galvanized steel roll formed. Bearings shall be oilite, ball bearing or nylon with steel shafts. Side seals shall be stainless steel of the tight-seal spring type. Dampers and seals shall be suitable for temperature ranges of -40 to 200F.

a. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.

b. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6".

c. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all control dampers with the temperature control submittal. Maximum leakage for dampers in excess of sixteen inches square shall be 30 CFM per square foot at static pressure of 1 inch of WC.

d. Where ultra-low leakage dampers are specified the blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage to 6 CFM per square foot for dampers in excess of sixteen inches square at 1 inch of WC.

3. Smoke dampers where indicated on the plans shall conform to the UL555S Leakage Class specified.

4. Automatic control valves 2" and smaller shall be threaded type, and valves 2 1/2" and larger shall be flanged. Valves shall be ANSI-rated to withstand the pressures and temperatures encountered. All automatic control valves shall be manufactured and assembled by an ISO 9001 Compliant facility.

5. Automatic control valves may be globe valve type, or ball valve type. Globe valves shall have stainless-steel stems, metal-to-metal seats, and spring loaded reinforced carbon filled Teflon packing. Globe valves shall have a leakage rate of 0.05% of rated Cv, or less. Globe valves shall have 50:1 rangeability or better. Ball valves shall have stainless steel stems, stainless steel balls, and multi-fill carbon Teflon seats. Ball valves shall have one EPDM o-ring stem seal and a minimum life expectancy of 200,000 full cycles and 750,000 re-positions. Ball valves shall be maintenance free; valves with adjustable packing are unacceptable. Ball valves not designed specifically for use with HVAC control systems are unacceptable.

   a. All modulating two-way water valves shall be provided with equal-percentage flow characteristics. All three-way valves shall be provided with flow characteristics such that the total flow through the valve shall remain constant regardless of the valve's position. Valves shall be sized for a pressure drop equal to the coil they serve but not to exceed 2 psi.

   b. All modulating steam valves (for steam over 15 psig) shall have a linear flow characteristic and stainless steel trim. Valves shall be sized for 15 psi entering steam and 5 psi pressure drop through valves.

   c. Unitary valves shall be two-way or three-way type as specified in the sequence of operation. Pressure ratings shall be as required for the intended service.

6. All automatically controlled devices, unless specified otherwise, shall in all cases be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close off. Ball valve actuators shall have enough torque to operate the ball valve even after 6 months of inactivity.

   a. Actuators for dampers shall be direct-coupled damper actuator type.

   b. Actuators for valves shall be of direct-coupled design, without the use of linkages or separately ordered brackets or adapters. These direct coupled valve actuators shall mount directly to the bonnet of the valve, and attach to the valve stem without adjustments. Direct coupled valve actuators and globe valves shall be manufactured by the same company.

   c. Actuators for valves may alternately be of the direct-coupled damper actuator plus rotary-to-linear linkage design. The globe valve linkage shall have an all-metal housing. All linkage gears shall be of rack-and-pinion design, and constructed of maintenance free self-lubricating powdered metal and/or steel. The linkage shall include an adjustable manual override handle that can be removed without affecting linkage operation. The linkage shall be able to withstand a minimum of 300 lb-in torque. The linkage shall require no disassembly or gear adjustment before, during, or after installation. Direct-coupled damper actuators and globe valve linkages shall be manufactured by the same company.

      1) Safety high limit shall be 135 degrees manual reset type when provided in the exhaust or return air and 10 degrees above the anticipated high temperature when provided in the supply air.

d. Electric low limit freeze protection thermostats shall be provided for all systems with water coils (whether or not described in sequence of operation) and have 20 ft. low point sensitive elements (not averaging type), installed to cover the entire cooling coil face area. The elements shall be suspended one-inch upstream of the cooling coils. These thermostats shall be two-position manual reset type. Where coils are 2 banks wide, multiple freeze protection thermostats wired in series shall be provided. Any one thermostat shall stop the supply fan and if specified, sound an alarm at the BMCS on a drop in temperature below its setting.

e. The heating coil controller shall act as a low limit and control the heating coil valve to maintain the minimum heating coil discharge air temperature during system "off" mode (45 F adj.).

7. Provide the following pressure switches on each system of supply and return fans on all systems. Wire switches to stop all fans when either switch opens.

a. One switch downstream of filters set to open when pressure drops below -2 1/2 " (adj.)

b. One switch downstream of fan discharge set to open when pressure exceeds 5" to 7" (adj.).

8. Duct smoke detectors shall contain an air-sampling chamber with sampling tubes extending through the width of the air duct. Alarm status indicating lights shall be visible on the front of the detector.

2.8 DATA INPUTS AND OUTPUTS

A. Input/output sensors and devices shall be closely matched to the requirements of the remote panel for accurate, responsive, noise-free signal input/output. Control input response shall be high sensitivity and matched to the loop gain requirements for precise and responsive control. In no case shall computer inputs be derived from pneumatic sensors.

B. Temperature sensors shall be Resistance Temperature Detector (RTD) type of 1000, or 3,000 ohm platinum, 20,000 ohm NTC, 0-10vdc, or 4-20ma. Sensors shall have + or - 1.0 degrees F accuracy between 32 degrees and 212 degrees.

1. UC Space Temperature Wall Modules shall be provided where shown on plans and shall be mounted 48" above finished floor with blank commercial type locking covers. Align vertically or horizontally with adjacent light switches or, if no light switch, with receptacles. Coordinate final location with the furniture layout and the architectural layout. Wall modules shall include a temperature sensor with the following features:

a. Sensor only:

1) Occupied/Unoccupied override with LED indicator
2) Set point control
3) Relative setpoint indication scale
4) Network jack

a) Plastic used on subbase or housing shall be UL94-5V rated.

b) Duct temperature sensors shall be rigid stem or averaging type as specified in the sequence of operation. Water sensors shall be provided with a separable copper, monel or stainless-steel well.

C. Water flow analog sensors shall be provided complete with flow element and shall be an all solid state precision industrial type with stainless-steel meter body, maximum error of no more than .5% of span, and 4 to 20 ma output. Sensor shall be rated for 250 psi minimum and installed in strict accordance to the manufacturer's instructions complete with three-valve manifold for calibration and maintenance.

D. Kilowatt transducers shall be the integrated electronic type with accuracy of .2% of scale. For balanced (such as motors) three phase loads, two current transformers (CTs) shall be provided and for unbalanced loads, three CTs shall be provided. Two or three potential transformers (PTs) shall be provided as recommended by the manufacturer for the application.

E. Analog output transducers shall be designed for precision closed loop control with pneumatic repeatability error no greater than 1 %.

F. Unless specified otherwise elsewhere, relative humidity sensors shall be capacitance type with 10% to 90% range. Duct mounted humidity sensors shall be provided with a sampling chamber.

G. Humidity sensors: industrial quality, capacitance type, with self-contained 4-20 ma transmitter. Accuracy shall be "2% RH in the range of 20-90%. The transmitter shall include non-interacting zero and span adjustments with an output error not exceeding 0.1% of calibrated span. Saturation shall not alter calibration Outside air relative humidity sensor used for enthalpy economizer decision shall be Vaisala model HMD 50U or HyCal HT-W. OSA versions shall be provided with outside wall mount in weather resistant NEMA 4 enclosure (4" probe and sunshield).

H. Current sensing relays used for proof-of-loading for fans and pumps shall be suitable for 2 to 200 amperes and shall have adjustable trip thresholds of plus or minus two percent of range wired on the load side of each fan or pump. Each relay shall be provided with an LED to allow ready observation of the relay status.

I. Fan proof-of-flow switches shall be adjustable set point and differential pressure type. Switches shall be piped across the fan. For fractional horsepower and non-ducted fans, relays or auxiliary contacts may be used. Maximum pressure rating shall be at least 10 inches WC.

J. Pump proof-of-flow switches shall be adjustable differential pressure or flow type as specified in the sequence of operation or data point summary. Devices shall be 150 psi rated except chilled water flow switches shall be provided with totally sealed vapor tight switch enclosure on 300 psi body. Differential pressure switches shall have valved manifold for servicing.

K. Carbon Dioxide (CO2) transmitters detection method shall be photo-acoustic range 0-2000PPM CO2 accuracy 100 PPM, 50 PPM typical at reference conditions), repeatability 2% full scale, drift 5% full-scale in 5 years Min detection concentration approx. 250 PPM operating environment - temperature 15 C to 40 C, humidity 15% - 95% RH non-condensing.

PART 3 EXECUTION

3.1 GENERAL

A. The BMCS shall be designed, installed, and commissioned in a turnkey operational manner; including all labor not noted in Work by Others paragraph of PART I of this section of these specifications, and not noted in other sections of these specifications.

B. Where control devices are installed on insulated piping or ductwork, provide standoff brackets or thermowells sized to clear insulation thickness. Provide extended sensing elements, actuator linkages, and other accessories as required.

3.2 SUBMITTALS

A. Provide 8 copies of submittal data.

B. Submittal shall consist of:

1. System architecture showing all digital devices.

2. Equipment lists of all proposed devices and equipment including data sheets of all products. Provide a PIC statement for each BACnet device and interoperability certification for each LonMark field device provided.

3. Valve, damper, and well and tap schedules showing size, configuration, capacity and location of all equipment.

4. Data entry forms for initial parameters. Contractor shall provide English listing of all analog points with columnar blanks for high and low warning limits and high and low alarm limits, and a listing of all fan systems with columnar blanks for beginning and end of occupancy periods; and samples of proposed text for points and messages (for at least two systems of at least 15 points total) including sample 480 character alarm message. All text shall be approved prior to data entry.

5. Wiring and piping interconnection diagrams including panel and device power and sources.

6. Software design data including flowchart of each DDC program showing interrelationship between inputs, PID functions, all other functions, outputs, etc. and detailed description of system operation relating to all flowchart functions.

3.3 INSTALLATION

A. All wiring and tubing shall be properly supported and run in a neat and workmanlike manner. All wiring and tubing exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. All wiring shall be in accordance with all local and national codes. All line voltage wiring, all wiring exposed, and all wiring in equipment rooms shall be installed in conduit in accordance to the electrical specifications. All electronic wiring shall be #18 AWG minimum THHN and shielded if required, except standard network (Ethernet, LonWorks, etc.) cabling shall be as tested and recommended in lieu of #18 gauge twisted, #22 or #24 gauge is acceptable if used as a part of an engineered structured cabling system. The control manufacturer must submit technical and application documentation demonstrating that this cabling system has been tested and approved for use by the manufacturer of both the control system and the engineered structured cabling system. All wiring in the central control room shall be concealed in an approved manner.

B. This contractor shall provide all sensing, control, and interlock wiring for the following unless shown or specified elsewhere by others.

1. BMCS inputs and outputs
2. BMCS communications
3. BMCS system power
4. Miscellaneous exhaust fan interlocks
5. Unit heater controls
6. Smoke damper end switches

C. The BMCS contractor shall enter all computer data into the related computers including all control programs, initial approved parameters and settings, and English descriptors. The BMCS contractor shall maintain diskette/CD copies of all data file and application software for reload use in the event of a system crash or memory failure. One copy shall be delivered to the owner during training sessions, and one copy shall be archived in the BMCS contractor's local software vault.

3.4 ACCEPTANCE

A. The BMCS contractor shall completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the approved specifications and sequences of operations approved.

B. Witnessed acceptance demonstration shall display and demonstrate each type of data entry to show site specific customizing capability; demonstrate parameter changes; execute digital and analog commands; and demonstrate DDC loop stability via trend of inputs and outputs.

C. The control contractor shall furnish a portable UC programming tool with preloaded software and necessary interface cable to the balancing contractor for use during system balancing. The balancing contractor shall be responsible for proper use and care of this tool, and shall return it to the control contractor immediately upon balancing completion. The control contractor shall provide the balancing contractor up to four hours training on the use of this tool in order to exercise actuators and enter calibration and balancing parameters. Additional training or assistance required by the balancing contractor shall be contracted directly with the control contractor by the balancing contractor.

3.5 MANUALS

A. The following manuals will be provided:

1. An Operators Manual shall be provided with graphic explanations of keyboard use for all operator functions specified under Operator Training.

2. Computerized printouts of all configuration data file including all point processing assignments, physical terminal relationships, scales and offsets, command and alarm limits, etc.

3. A manual shall be provided including revised as-built documents of all materials required under the paragraph "SUBMITTALS" on this specification.

4. Two Operators Manuals and two As-Built Manuals shall be provided to the owner.

3.6 TRAINING

A. All training shall be by the BMCS contractor and shall utilize operators' manuals and as-built documentation.

B. Training shall include one eight-hour sessions encompassing modifying text, sequence of operation review, selection of all displays and reports, use of all specified OWS functions, use of Portable Operators Terminals, troubleshooting of sensors (determining bad sensors), and password assignment and modification

END OF SECTION

SECTION 23 09 15

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of variable frequency drives work is indicated by drawings and schedules and by requirements of this section.

B. The variable frequency drives for this Project shall be of the pulse width modulated type.

C. Provide the following electrical work as work of this section, in compliance with electrical specifications.

1. Control and interlock wiring between operating controls, indicating devices, unit temperature control panels and variable frequency drive.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of variable frequency drives, of types and capacities required, where products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: A firm specializing and experienced in variable frequency drive installations for not less than five (5) years.

C. Codes and Standards:

1. Electrical Standards: Provide electrical components of variable frequency drives which have been UL Listed and labeled, and comply with NEC Standards.

2. NEMA Compliance: Comply with NEMA Standards pertaining to components and devices.

3. ETL Compliance: Provide variable frequency drives with ETL approved label.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties, contactors and accessories; and installation and start-up instructions.

B. Coordination Data: Submit nameplate information for each motor to be operated by VFD.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances and methods of assembly of components.

D. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for variable frequency drives. Submit manufacturer's ladder-type wiring diagrams for interlock and

control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field installed.

E. Operating Conditions: Submit manufacturer's printed information clearly stating ambient temperature requirement and carrier frequency at rated conditions.

F. Maintenance Data: Submit maintenance data and parts list for each variable frequency drive, control, and accessory; including "Trouble-Shooting" Maintenance Guide. Include this data and product data in Maintenance Manual.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handle variable frequency drives carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.

B. Store variable frequency drives in clean, dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading variable frequency drives and moving units to final location for installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide variable frequency drives of one (1) of the following:

1. ASEA Brown Boveri
2. Cutler-Hammer
3. Halmar-Robicon Group
4. Magnetek
5. Reliance
6. Square D
7. Toshiba

B. All VFD's shall be of the same manufacturer. The Contractor shall verify that the size of the equipment supplied by the selected manufacturer does not exceed the available mounting space.

C. The Contractor shall verify lead length between the VFD and associated motor. Output reactor or other device shall be provided as required to operate associated motor without damage to the motor windings.

2.2 GENERAL

A. Establish requirements for variable voltage variable frequency motor controls, for speed control of fans, blowers or pumps driven with AC motors.

B. Contractor shall coordinate exact locations of all motors controlled from a VFD and provide motors rated for VFD operation. In addition motors shall be suitable for across-the-line starting.

2.3 VARIABLE FREQUENCY MOTOR CONTROL

A. Pulse Width Modulation VFD:

1. The controller shall produce an adjustable AC voltage/frequency output. It should have an output voltage regulator to maintain correct output V/Hz. despite incoming voltage variations.

2. The VFD shall be of the Pulse-Width Modulated type and shall consist of a full-wave diode bridge converter to convert incoming fixed voltage/frequency/ to a fixed DC voltage.

3. The inverter output shall be generated by power transistors or IGBT's (isolated gate bipolar transistors).

4. The logic control section shall be microprocessor based.

2.4 SPECIFICATION

A. Verify power input requirements with drawings.

1. Nominal input voltage +/ - 10%
2. Input frequency stability 48-62 HZ

B. Provide minimum 3% AC Input Line Reactor.

C. Output power; 3-phase, 1.5 to 60 Hz with variable voltage to give proper and efficient operation of variable torque load.

D. Displacement power factor - Minimum of 90% over the entire speed range.

E. VFD shall be rated for HP rating indicated on drawings. Additionally amp rating shall not be less than National Electrical Code, Table 430-150 for corresponding HP size indicated. HP and current ratings noted above shall be minimum values after any/all derating factors such as frequency, elevation, ambient temperature, etc. have been applied. Ratings shall be based on 40°C ambient temperature and a carrier frequency of 4,500 to 8,000 KHz.

F. Minimum overload capacity of 125% for one (1) minute. In lieu of providing the above stated overload capacity provide VFD for the next larger standard HP rating (example: Motor rated 3 HP, 480V, 3-phase, full load current 4.8-amps. VFD output current 4.8-amps, overload capacity 110% for one (1) minute. Provide VFD rated for 5 HP, output current minimum 7.6-amps.)

2.5 MINIMUM REQUIREMENTS FOR CONTROL OPERATION

A. Fused input door interlocked disconnect.

B. Isolated 115VAC control transformer.

C. Annunciated or digital display and time stamp of the following fault and limit functions for:

1. Thermal overload relay trip.
2. Microprocessor self-check function.
3. Output overcurrent trip.
4. DC bus overvoltage trip.

5. Inverse time overload trip.
6. Heat sink overtemperature trip.
7. DC bus fuse open.
8. DC bus overvoltage (regen. limit).
9. Output ground fault.
10. Inverter ready light.
11. Inverter run light.
12. Bypass run light.
13. Bypass safety lockout light (red).
14. Inverter safety lockout light (red).
15. Power line on light.
16. Control voltage enabled light.

2.6 MINIMUM REQUIRED STANDARD FEATURES

A. Provide input disconnecting means, either a switch or circuit breaker. Disconnects shall be capable of being locked in the open position.

B. Provide VFD input fuses rated for protection of semiconductors.

C. Door Mounted Components:

1. Inverter run indication.
2. Bypass run indication.
3. Digital speed (frequency or percent speed) and motor ammeter.
4. Manual speed adjustment.
5. Inverter / Off / [Bypass switch].
6. Reset for fault and enable.
7. Manual / Auto reference selector.
8. Annunciation as in Section 2.5.

D. DC bus charged indicator.

E. Current limit circuit active to prevent nuisance tripping during acceleration or run conditions.

F. Regeneration limit circuit active to prevent nuisance OV tripping during deceleration.

G. Minimum and maximum speed set, separate and non-interactive.

H. Power loss restart selectable for Auto Restart in auto mode only.

1. Automatic restart from undervoltage, power failure, or control fault or both.

I. Critical frequency lockout for up to two (2) points, available from 10% to 100% speed with at least a 6 Hz bandwidth.

J. Only non-filament type indicating lights may be used.

K. Control shall survive without component failure and annunciate output phase to phase and phase to ground faults.

L. Control shall have the following isolated instrument signal follower that is compatible with temperature control system:

1. 4 to 20 madc.
2. 0 to 10 vdc.

M. Loss of reference protection, VFD shall reset to predetermined minimum speed until such time as the control is commanded to stop or the analog reference returns to normal.

N. Control shall have available 15 selectable volts per hertz patterns.

O. Volts per hertz ratio shall be automatic, tracking motor load requirements to achieve most efficient operation within the parameters set by the volts per hertz pattern. Potentiometer adjustments not allowed.

P. VFD shall have adjustable automatic restart capabilities and be capable of starting into a spinning motor.

Q. Control must be capable of starting into a spinning motor and switching from inverter to bypass back to inverter without delay and without tripping off line of the inverter, also must be capable of stopping a motor rotating in the reverse direction and then accelerating that motor in the proper direction

R. All components must be supplied in an enclosure.

S. Manual Bypass Control. A bypass control shall be provided for the purpose of running the AC motor at full speed with line power while the VFD is being serviced. Bypass and drive shall be electrically interlocked. The VFD package shall be configured so that the VFD can be removed for service with the bypass control left in place.

T. The bypass control enclosure shall include the following:

1. NEMA 1 Enclosure
2. Door Interlock Disconnect
3. NEMA Rated Bypass, VFD Output and VFD Input Contactors*
4. Line Select Light
5. Drive Off-line Selector
6. Power On Light
7. VFD Select Light
8. Overload Relay
9. 115 VAC Control Transformer

*VFD Input Contactor shall be manually operated.

U. System shall have an adjustable setting to allow a power line dip ride through of four (4) cycles.

V. Up to four (4) programmable pre-set speeds.

W. Honeywell Lon Mark communication card.

X. Drive output reference signal:

1. 0 to 10 vdc
2. 4 to 20 ma

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which variable frequency drive systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF VARIABLE FREQUENCY DRIVE SYSTEMS

A. General: Install system and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable electrical specifications. Mount controllers at convenient locations and heights.

3.3 CLEANING

A. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of variable frequency drives, including electrical connections. Report results in writing.

1. Test and adjust controls and safeties.
2. Replace damaged and malfunctioning controls and equipment.

3.5 COMMISSIONING

A. Startup Services: Engage a factory-authorized service representative to perform startup services and field report.

B. Operate motors and verify proper rotation and connections.

C. Operate controls and verify proper response to control inputs.

D. Submit a list of all adjustable and non-adjustable operating parameters along with actual settings and adjustment ranges.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance.

2. Review data in the maintenance manuals.

3. Schedule training with Owner, through Architect, with at least seven (7) days' advance notice.

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Sequence of operation is hereby defined as the manner and method by which controls function. Requirements for each type of control system operation are specified in this section.

1.2 SUBMITTALS

A. Shop Drawings: Submit shop drawings for each system automatically controlled, containing the following information:

1. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves and control devices.

2. Label each control device with setting or adjustable range of control.

3. Indicate pneumatic piping; factory and field wiring.

4. Indicate each control panel required, with internal and external piping and wiring clearly indicated. Provide detail of panel face, including controls, instruments, and labeling. Include verbal description of sequence of operation.

B. Maintenance Data: Include copy of shop drawings in each Maintenance Manual.

PART 2 - PRODUCTS (not applicable to this section).

PART 3 - EXECUTION

A. Refer to the mechanical drawings for the control schematics and the control sequences.

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes piping systems for hot water heating, chilled water cooling, glycol loop, make-up water for these systems, blow-down drain lines, and condensate drain piping.

B. Types of hydronic piping and specialties specified in this section include the following:

1. Piping and Fittings
2. Automatic Flow Control Valves
3. Air Vents
4. Y Pattern Strainers
5. Ethylene Glycol Solution
6. System Cleaning and Water Treatment

1.2 SUBMITTALS

A. Product Data: From manufacturer's, for each hydronic specialty and special duty valve specified, include rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions.

1. Furnish flow and pressure drop curves for calibrated plug valves, based on manufacturer's testing.

B. Shop Drawings: Detailing dimensions, weight loadings, required clearances, methods of assembly of components, and location and size of each field connection.

C. Maintenance Data: For hydronic specialties and special duty valves, for inclusion in operation and maintenance manual.

D. Quality Control Submittals:

1. Welders' certificates certifying that welders comply with the quality requirements specified in Quality Assurance below.

2. Certification of compliance with ASTM and ANSI manufacturing requirements for pipe, fittings, and specialties.

3. Submit reports specified in Part 3 of this Section.

a. Hydronic Piping System Testing Report.
b. Hydronic Piping System Cleaning Report.

1.3 QUALITY ASSURANCE

A. Qualifications for Welding Processes and Operators: ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification."

B. Regulatory Requirements:

1. ASME Compliance: Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.4 MAINTENANCE

A. Maintenance Stock: Furnish a sufficient quantity of chemical for initial system start-up and for preventive maintenance for one (1) year from Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide hydronic piping system products from one (1) of the following:

1. Grooved Mechanical Joint Pipe, Fittings, and Couplings:

a. Gruvlok; Anvil Industries.
b. Tyco-Grinnell
c. Victaulic Company of America

2. Calibrated Plug Valves:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Flow Design, Inc.
d. Gerand Engineering Co.
e. ITT Fluid Technology Corp.; ITT Bell & Gossett
f. Taco, Inc.

3. Automatic Flow-Control Valves:

a. Flow Design
b. Griswold Controls
c. Hays
d. Nexus

4. Air Vents (manual and automatic):

a. Armstrong Machine Works
b. Bell & Gossett ITT; Fluid Handling Div.
c. Hoffman Specialty ITT; Fluid Handling Div.
d. Metraflex Co.
e. Spirax Sarco

5. Y-Pattern Strainers:

a. Armstrong Machine Works
b. Hoffman Specialty ITT; Fluid Handling Div.
c. Metraflex Co

d. Spirax Sarco
e. Trane Co.
f. Victaulic Company of America

6. Ethylene Glycol:

a. DowTherm; The Dow Chemical Co.
b. Intercool NFD; Interstate Chemical Co.
c. Wintrex; Houghton Chemical Corp.

2.2 PIPE AND TUBING MATERIALS OPTIONS (SELECTED OPTIONS SHALL COMPLY WITH ALL LOCAL CODES)

A. Material Options for Hot Water Heating, Glycol Anti-Freeze Solutions, and Chilled Water Piping:

1. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B) (above ground only).

2. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).

3. Steel Pipe, 2-inch NPS (DN50) and Smaller: ASTM A 53, Type S (seamless), Grade A, Schedule 40, plain ends.

4. Steel Pipe, 2-1/2-inch to 12-inch NPS (DN65 to DN300): ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, plain ends.

5. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, carbon steel, seamless for 2-inch NPS (DN50) and smaller and electric-resistance welded for 2-1/2-inch NPS (DN65) and larger.

B. Material options for Cooling Condensate Drain Piping:

1. Type M copper with solder type drainage fittings.

2.3 FITTINGS

A. Wrought-Copper Fittings: ASME B16.22.

B. Wrought-Copper Unions: ASME B16.22.

C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300.

D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300, with threads conforming to ASME B1.20.1.

E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

F. Cast-Iron Threaded Flanges: ASME B16.1, Classes 125 and 250; raised ground face, bolt holes spot faced.

G. Wrought-Steel Fittings: ASTM A 234 (ASTM A 234M), Standard Weight.

H. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

I. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile-iron; ASTM A 47 (ASTM A 47M), Grade 32510 malleable-iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.

J. Grooved Mechanical-Joint Couplings: Consist of ductile- or malleable-iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

K. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body, steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250°F (121°C) and pressures up to 150 PSIG (1035 kPa).

2.4 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.

B. Brazing Filler Metals: AWS A5.8, Classification BAg 1 (silver).

C. Welding Materials: Comply with Section II, Part C of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

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

2.5 SPECIAL DUTY VALVES

A. General: Special duty valves are specified in this Article by their generic name; refer to Part 3 Article "VALVE APPLICATION" for specific uses and applications for each valve specified.

B. Circuit Setter Valves: 125 PSIG water working pressure, 250°F maximum operating temperature, bronze body, brass ball construction with adjustable proportional valve. Valve shall have memory stop to close valve and re-open to setpoint. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. Valves 2-inch and smaller shall have sweat connections or threaded connections. Valves 2 1/2-inch and 3-inch shall have threaded connections.

C. Automatic Flow Control Valves: Class 150, cast-iron housing, stainless steel operating parts; threaded connections for 2-inch and smaller, flanged connections for 2-1/2-inch and larger. Factory set to automatically control flow rates within plus or minus 5% design, while compensating for system operating pressure differential. Provide quick disconnect valves for flow measuring equipment. Provide a metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and flow rate in GPM.

1. Flow Range: 1-14 PSIG.

2. Provide flow and pressure range as required for each application.

2.6 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 175 PSIG working pressure, 250°F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8-inch discharge connection and 1/4-inch inlet connection.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and non-ferrous internal parts; 150-PSIG working pressure, 250°F operating temperature; with 1/4-inch NPS discharge connection and 1/2-inch NPS inlet connection.

C. High Capacity Automatic Air Vent: Designed to vent automatically with float principle; cast iron body and non-ferrous internal parts; 175-PSIG working pressure, 250°F operating temperature; with 1/2-inch NPS discharge connection and 3/4-inch NPS inlet connection.

D. Y-Pattern Strainers: Cast-iron body (ASTM A 126, Class B), flanged ends for 2-1/2-inch and larger, threaded connections for 2-inch and smaller, bolted cover, perforated Type 304 stainless steel basket, bottom drain connection; 175 PSIG working pressure.

E. Manual Chemical Feeder: Bypass type chemical feeders of 5-gallon capacity, welded steel construction; 200 PSIG working pressure; complete with fill funnel and inlet, outlet, and drain valves. Quarter-turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

F. Hydronic System Cleaning Solution: As required by the cleaning methods described in Part 3 - Execution.

2.7 GLYCOL-BASED SOLUTIONS

A. Ethylene Glycol: Furnish industrially inhibited ethylene glycol containing corrosion inhibitor for all metals including yellow metals.

B. Glycol shall be suitable for a bulk operating range of -25°F to 300°F and a maximum film temperature of 320°F.

C. Refer to drawings and schedules for glycol concentration by volume.

D. The glycol must be dyed to facilitate leak detection.

E. The glycol must pass ASTM D1384 (less than 0.5 mil penetration per year for all system metals).

PART 3 - EXECUTION

3.1 PIPE APPLICATIONS

A. Where copper tubing is allowed, use Type L, drawn copper tubing with wrought copper fittings and solder joints for 2-inch and smaller, above ground, within building. Use Type K, annealed temper copper tubing for 2-inch and smaller without joints, below ground or within slabs. Mechanical fittings (crimp or flair) are not permitted.

B. Where steel pipe is allowed, use steel pipe with threaded fittings for 2-inch and smaller, and with welded or grooved joints for 2-1/2-inch and larger.

C. In systems containing glycol-based solution, galvanized piping, valves or fittings, or any other component containing zinc is prohibited.

D. The use of glycol-based solutions is not recommended with aluminum systems or components at temperatures above 150°F.

3.2 PIPING INSTALLATIONS

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

B. Extreme care shall be exercised by the Contractor to prevent dirt and other foreign matter from entering pipe or components of system during construction. Pipe stored on Project shall have open ends capped and equipment shall have all openings fully protected. Before erection, each piece of pipe, fitting or valve shall be visually examined and all dirt removed.

C. Install piping at a uniform grade of 1-inch in 40-feet upward in the direction of flow.

D. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.

E. Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.

F. Install unions in pipes 2-inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

G. Install flanges on valves, apparatus, and equipment having 2-1/2-inch and larger connections.

H. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration producing equipment.

I. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blow down connection of strainers 2-inch and larger.

J. Anchor piping to ensure proper direction of expansion and contraction.

K. Support: The requirements of MSS-SP-69 "Pipe Hangers and Support - Selection and Application" shall, in general, govern the installation of hangers and supports, in accordance with the manufacturer's recommendations and with the following minimum spacings:

Nominal Pipe Size (Inches)	Max. Span Between Supports (Feet)
3/4	8
1	9
1-1/4	11
1-1/2	12
2	12
2 1/2	12
3	12

4	14
5	14
6	16
8	18
10	20
12	22
16	22

3.3 VALVE APPLICATIONS

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

1. Shut-off duty: Use ball and butterfly valves.

2. Throttling duty: Use ball and butterfly valves.

3. Install shut-off duty valves at each branch connection to supply and return mains, at supply and return connection to each piece of equipment, and elsewhere as indicated.

4. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

B. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

C. Install check valves on each pump discharge and elsewhere as required to control flow direction.

D. Install safety relief valves on hot water generators, and elsewhere as required by ASME Boiler and Pressure Vessel Code. Comply with ASME Boiler and Pressure Vessel Code Section VIII, Division 1 for installation requirements.

1. On heating hot water systems containing ethylene glycol or propylene glycol, pipe the discharge from the safety relief valve and boiler drians to an atmospheric collection tank. The ends of the piping shall be visible to determine if the valve is leaking past the seat. No valves shall be installed in the safety relief discharge piping.

2. On heating hot water systems in which no contaminants are present, pipe the discharge from the safety relief valve and boiler drains to floor drains. No valves shall be installed in the safety relief discharge piping.

E. Note that all valves required by this Section may not be shown on the drawings.

3.4 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in the system, at heat transfer coils, and elsewhere as required for system air venting. For inaccessible vent locations, the vent piping shall be piped to a location where vent will be accessible.

B. Glycol System: Thoroughly clean and flush system before adding glycol solution. The chilled water, heating hot water, and Crac Unit water systems shall be filled with 50% ethylene glycol/50% water solutions.

C. Note that all hydronic specialties required by this Section may not be shown on the drawings.

3.5 FIELD QUALITY CONTROL

A. Testing Preparation: Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush system with clean water. Clean strainers.

4. Isolate equipment that is not subjected to test pressure from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Flanged joints where blinds are inserted to isolate equipment need not be tested.

5. Install relief valve set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Testing: Test hydronic piping as follows:

1. Use ambient temperature clean water as testing medium.

2. Use vents installed at the high points of system to release trapped air while filling system. Use drains installed at low points for complete removal of liquid.

3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low-pressure filling lines are disconnected.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Check to verify that stress due to pressure at bottom of vertical runs does not exceed either 90% of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, Code for Pressure Piping, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing and submit to Project Engineer and Owner's Representative for review.

3.6 ADJUSTING AND CLEANING

A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

B. Close drains and refill systems for operation under normal closed loop conditions. HVAC Contractor shall add trisodium phosphate in an aqueous solution to system, prepared in a proportion of 1 lb/50 gallons of water in the system. After system is filled with this solution, the circulating pump should be started, trapped air vented, and the boiler set to supply approximately 100°F loop temperature. Solution shall circulate for approximately three (3) hours.

C. System then shall be drained completely and refilled with fresh water. After system has been completely cleaned as specified herein, it shall be tested by litmus paper or other dependable methods and left on slightly alkaline side (PH 7.5). If system is still on acid side, cleaning by use of trisodium phosphate shall be repeated.

D. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

E. Chemical Treatment: Provide a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.

3.7 COMMISSIONING

A. Fill system and perform initial chemical treatment.

B. Check expansion tanks to determine that they are not air bound and that system is completely full of water.

C. Perform these steps before operating the system:

1. Open valves to fully open position. Close coil bypass valves.

2. Check pump for proper direction of rotation.

3. Set automatic fill valves for required system pressure.

4. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.

6. Check operation of automatic bypass valves.

7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.

8. Lubricate motors and bearings.

END OF SECTION

SECTION 23 30 00

AIR DISTRIBUTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of air distribution work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Types of air distribution work specified in this section include the following:

1. Air filters and gages:

a. Replaceable (Throwaway).
b. Extended service.
c. Filter gages.

2. Metal Ductwork:

a. Duct liner
b. Flexible Duct.

3. Ductwork Accessories:

a. Manual dampers.
b. Smoke dampers.
c. Fire dampers.
d. Turning vanes.
e. Flexible connections.
f. Floor curbs.

4. Air outlets and inlets:

a. Diffusers, registers and grilles.
b. Louvers.

5. Air terminals:

a. Shut-off single duct.

C. Duct mounted smoke detector installation is included as work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air distribution products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with air distribution systems similar to that required for Project.

C. Codes and Standards:

1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" 1995 2nd Edition for fabrication and installation of metal ductwork.

2. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 96 "Standard for Ventilation Control and Fire Protections of Commercial Cooking Operations", NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".

4. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".

5. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.

6. ARI Compliance: Provide air terminals which have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.

7. ASTM C 1071: Duct liner shall comply with ASTM C 1071.

8. NAIMA FGDLS: Install duct liner in accordance with NAIMA FGDLS (North American Insulation Manufacturers Association's Fibrous Glass Duct Liner Standard).

9. ASHRAE Compliance: Comply with provisions of ASHRAE Standard 52 for method of testing and rating air filter units.

1.3 SUBMITTALS

A. Product data: Submit manufacturer's technical product data on all air distribution work, including performance data for air flow pressure drops through filters, noise criteria, air inlet, outlet and terminal room schedules, material construction and installation instructions.

B. Shop drawings: Submit manufacturer's assembly-type shop drawings, including dimensions, materials, finish, mounting details and methods of assembly for all air distribution equipment. Submit scaled layout drawings of metal ductwork and fittings including, but not limited to duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials and rigidity are not reduced.

NOTE: Coordinate sound output of each air device and modify sizes or arrangements as required to meet sound criteria listed on drawings.

C. Maintenance Data: Submit maintenance data and spare parts lists, cleaning and trouble shooting instructions. Include this data, product data and shop drawings in Maintenance Manual.

D. Record Drawings: At project closeout, submit record drawings of installed ductwork, duct accessories and air outlets and inlets.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide air distribution equipment of one (1) of the following:

1. Air Filters

a. American Air Filter Co.
b. Camfil Farr
c. Continental Air Filters
d. Eco-Air Products, Inc.

2. Filter Gages

a. Camfil Farr
b. Dwyer Instruments, Inc.

3. Round Spiral Ductwork and Fittings:

a. Lindab, Inc.
b. Norlock.
c. Sheet Metal Connectors.
d. United McGill.
e. Wesco.
f. Wichita Sheet Metal.

4. Flexible Ductwork:

a. TechnaFlex Type 57-C.
b. ThermaFlex Type M-KE.

5. Fire and Smoke Dampers

a. Air Balance, Inc.
b. Greenheck
c.
d. Leader, Dampers & Louvers
e. Louver & Dampers, Inc.
f. Nailor Industries
g. NCA
h. Pottorf
i. Ruskin
j. Sheet Metal Connectors.

6. Access Doors:

a. Ductmate Industries, Inc.
b. Sheet Metal Connectors, Inc.

7. Diffusers, Registers and Grilles:

a. Carnes
b. Krueger
c. E.H. Price
d. Metal Aire
e. Titus
f. Tuttle & Bailey

8. Louvers:

a. Aerolite
b. Airline Products Co.
c. Airstream Products Division of Penn Ventilator Co.
d. American Warming
e. Greenheck
f. Louvers & Dampers Inc.
g. NCA
h. Reliable
i. Ruskin
j. Safe-Air/Dowes

9. Air Terminal Control Units:

a. Carnes
b. Environmental Technologies
c. Krueger
d. E.H. Price
e. Titus

2.2 AIR FILTERS AND GAGES

A. Replaceable (Throwaway) Panel Filters: Provide factory-fabricated, viscous-coated, flat panel type replaceable air filters with holding frames; as indicated, in sizes indicated, with 2-inch thick UL Class 2 throwaway media material; construct media of interlaced glass fibers, spray with non-flammable adhesive, frame in throwaway fiberboard casings, and sandwich between perforated metal grills. Construct ductwork-holding frames of 20-gage galvanized-steel, capable of holding media and media frame in place, and gasketed to prevent unfiltered air by-passing between media frames and holding members. Provide filters with rated face velocity of 500 FPM, initial resistance of not greater than 0.30-inch w.g., final rated resistance of 0.50-inch w.g., and average arrestance of 80%.

B. Extended Surface Filters: Provide factory-fabricated, dry, extended surface filters with holding frames; where shown, in sizes indicated. Equip with UL Class 1 fibrous media material formed into 6-inch deep V-shaped pleats and held by self-supporting wire frames. Construct holding frames of 18-gage galvanized-steel and provide suitable fasteners and gasketing to hold media and media frame and to prevent unfiltered air passing between media frames and holding devices. Design holding frames which are suitable for bolting together into built-up filter banks. Provide filters with rated face velocity of 500 FPM, initial resistance of 0.50-inch w.g. with 60-65% dustspot efficiency, and 0.60-inch w.g. with 90-95% dustspot efficiency and final rated resistance 1.2-inch w.g.

C. Class 2 30/30 Filters

1. Air Filters - Air filters shall be 2-inch Farr 30/30, medium efficiency, pleated, disposable type. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2.

2. Filter Media - Filter media shall be of the non-woven cotton fabric type. The filter media shall have an efficiency of 30% on ASHRAE Test Standard 52-76. It shall have an average arrestance of 90-92% in accordance with that test standard. The effective filter media shall be not less than 4.6 square feet of media per 1.0 square foot of filter face area and shall contain not less than 15 pleats per linear foot. Initial resistance at 500 FPM approach velocity shall not exceed .28-inch w.g.

3. Media Support Grid - The media support shall be a welded wire grid with an effective open area of not less than 96%. The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull away. The media support grid shall be formed in such a manner that if effects a radial pleat design, allowing total use of filter media.

4. Enclosing Frame - The enclosing frame shall be constructed of a rigid, heavy-duty, high wet-strength beverage board, with diagonal support members bonded to the air entering and air exit side of each pleats, to ensure pleat stability. The inside periphery of the enclosing frame shall be bonded to the filter pack, thus, eliminating the possibility of air bypass.

5. Holding Frame - Holding frames shall be Farr Type 8, factory fabricated of 16-gage galvanized-steel and shall be equipped with gaskets and four (4) spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without the use of tools.

D. Provide manometer-type filter gage for each filter bank, with logarithmic curve tube gage, with integral leveling gage, graduated to read from 0- to 3-inch w.g.

1. Provide pressure tips, tubing, gage connections and mounting bracket.

2.3 METAL DUCTWORK

A. Materials:

1. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations and other imperfections, including those which would impair painting.

2. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A 700.

3. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653, Coating Designation G 90. All shipping labels, markings or identification tags shall be removed from galvanized steel upon installation. Where duct is indicated to be painted, provide mill phosphatized finish for exposed surfaces of ducts exposed to view. Refer to architectural plans for extent of painted surfaces. All other surfaces of duct exposed to view shall have bright finish.

4. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized-steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.

5. 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.

B. Miscellaneous Materials:

1. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch takeoff connections. Where 90 degree branches are indicated, provide conical type tees.

2. Joint and Seam Sealant: Indoor/Outdoor Water Based Duct Sealant shall be all purpose duct sealant for use on all types of metal duct, glass fiber duct board, and flex duct, as well as duct fabric and flexible tubing runouts. The sealant incorporates a built-in fiber reinforcement for exceptional strength, with UV inhibitors for outdoor use. UL 181A-M Listed / UL 181B-M Listed. Provide Versa-Grip 181 Hardcast or approved equal.

3. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

4. Fire Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

5. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized-steel fasteners, anchors, rods, straps, wire rope, trim and angles for support of ductwork. Hang all ductwork from the structure only. Do not hang from metal deck.

6. Flexible Duct: Factory pre-insulated duct composed of a corrosion-resistant reinforcing wire helix permanently bonded and enclosed in polyester film, then covered with 1-1/2-inch, 3/4 lb. density fiberglass insulation blanket sheathed in a vapor barrier of aluminum metalized polyester film laminated to glass mesh, elastomer back-coated. The duct must comply with the latest NFPA Standard 90A and be listed as a Class 1 Air Duct Material, UL Standard 181.

7. Floor Curbs: At all ductwork penetrations through floors above grade provide concrete or steel angle curb extending 3-inches above finish floor level and provide watertight seal at floor line.

C. Fabrication:

1. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-16 and 1-21 through 1-25, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications and joint types and intervals.

2. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

3. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:

   a. Supply Ducts: Where no specific duct pressure class designations are indicated, fabricate duct system for 1-inch water gage pressure class, except for ducts upstream from variable air volume boxes. Fabricate duct system components upstream from variable air volume boxes for 4-inch water gage pressure class.

   b. Ventilation Ducts: 2-inch water gage pressure class.

   c. Outside Air and Mixed Air Ducts: 2-inch water gage pressure class.

   d. Return Ducts: 1-inch water gage, negative pressure.

   e. Exhaust Ducts: 1-inch water gage, negative pressure.

4. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains and discolorations.

5. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19-inches and larger and are 20-gage or less, with more than 10 square feet of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-4, unless they are lined or are externally insulated.

6. Rectangular Duct Fittings: Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1995 Edition, Figures 2-1 through 2-8.

7. Ductmate Fittings: Joints constructed in accordance with SMACNA Standards that use four (4) corner connections shall be equal to products manufactured by Ductmate Industries Inc., Ward Industries Inc. or an approved equal. Refer to manufacturer's guidelines.

D. Round Concealed Ductwork: Fabricate round supply ducts using seam types identified in SMACNA "HVAC" Duct Construction Standards, "1995 Edition, Figure 3-1, RL-1, RL-4 or RL-5. Seams Types RL-2 or RL-3 may be used if spot-welded on 1-inch intervals. Comply with SMACNA "HVAC" Duct Construction Standards", Table 3-2A and 3-2B for galvanized-steel gages.

E. Longitudinal Seams: Pittsburgh lock shall be used on all longitudinal seams.

1. Snap-lock seams are acceptable downstream of VAV terminal units.

2. If SMACNA seal Class A or B is specified, the longitudinal seam shall be sealed from the inside.

F. Round Exposed Ductwork: Construct of galvanized sheet steel complying with ASTM A 527 by the following methods and in minimum gages listed:

DIAMETER	MINIMUM GAGE	METHOD OF MANUFACTURE

3-inch to 14-inch	26	Spiral Lockseam
15-inch to 26-inch	24	Spiral Lockseam
27-inch to 36-inch	22	Spiral Lockseam
37-inch to 50-inch	20	Spiral Lockseam
51-inch to 60-inch	18	Spiral Lockseam
Over 60-inch	16	Longitudinal Seam

1. Fittings and Couplings: Construct of minimum gages listed. Provide continuous welds along seams.

DIAMETER	MINIMUM GAGE
3-inch to 36-inch	20
38-inch to 50-inch	18
Over 50-inch	16

2. Transverse spiral and round duct joints for all exposed ductwork shall be made with the Spiralmate round duct connector or an approved equal. The Spiralmate components shall be of standard catalogue manufacture as supplied by Ductmate Industries, Inc., Ward Industries Inc. or an approved equal.

3. The installation of the Spiralmate round duct connector shall be in accordance with the manufacturer's printed instruction and installation manuals.

4. The Spiralmate round duct connector consists of the following components:

   a. Two (2) mating round duct connector flanges with an integral sealant.
   b. A gasket between the two (2) mating flanges.
   c. A roll-formed closure ring that is drawn tight with a bolt and nut.

G. Flat Oval Ducts: Install using the Ovalmate Connection system manufactured by Ductmate Industries, Inc. Consult the manufacturer for installation and construction guidelines.

2.4 DUCTWORK ACCESSORIES

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "Low Pressure Duct Standards".

B. Fire Dampers: Provide fire dampers, of types and sizes indicated. Fire Dampers shall be dynamic type and shall be constructed and tested in accordance with UL Safety Standard 555. Fire dampers used for the protection of openings in walls, partitions or floors with fire resistance ratings of less than three (3) hours shall have 1-1/2 hour fire protection rating. Fire dampers used for the protection of openings in walls, partitions or floors having a fire resistance rating of three (3) hours or more, shall have a three (3) hour fire protection rating. Provide fusible link rated at 165°F unless otherwise indicated. Fire dampers shall be equipped for vertical or horizontal installation as required by the location shown. Fire dampers shall be installed in wall and floor openings utilizing steel sleeves, angles, other materials and practices required to provide an installation equivalent to that utilized by the manufacturer when dampers were tested at UL. Fire dampers shall include UL label. Each dynamic fire damper shall include a steel sleeve and retaining angles furnished by the damper manufacturer to ensure appropriate installation. Submittal information shall include the fire protection rating, maximum velocity/pressure ratings and the manufacturer's UL installation instructions. Each fire damper shipment shall include the

same UL installation instructions. The dampers shall be installed in accordance with these instructions.

1. Dampers shall be Style B or equal design providing a nominal 100% free area fire damper. Ruskin Type DIBD or approved equal.

2. Provide 12-inch x 12-inch (minimum) duct access door at fire dampers to allow maintenance and visual inspection per NFPA requirements.

C. Ceiling Radiation Dampers: Provide ceiling radiation dampers of types and sizes as indicated. Fire Dampers shall be constructed and tested in accordance with UL. Each fire dampers shall have a 1-1/2 hour fire protection rating. Provide fusible link at 165°F. Fire dampers shall be suited for round or rectangular openings as shown. Fire dampers shall include UL Label.

1. Dampers shall be Ruskin CFD or CFDR or equal.

2. Shop drawings shall include manufacturer's recommended installation instruction as tested by UL.

3. Damper Blade Assembly: Multi-blade type.

4. Blade Material: Steel, match casing.

D. Smoke Dampers: Smoke dampers shall be UL Labeled according to UL Standard 555S, Standard for Leakage Rated Dampers for Use in Smoke Control Systems." Combination fire and smoke dampers shall also be UL Labeled for 1-1/2 hour rating according to UL Standard 555 "Standard for Fire Dampers."

1. Provide replaceable, 165°F or 212°F rated fusible link as required.

2. Frame and Blades shall be constructed of 16-gage galvanized-steel.

3. Provide factory-installed, 18-gage galvanized-steel mounting sleeve of length to suit wall or floor applications. All smoke dampers shall be leakage Class II with a maximum leakage of 10 cfm/ft^2 at 1-inch SP unless indicated otherwise.

4. All combination fire/smoke dampers shall incorporate an integral resettable and reusable UL Listed electric-ambient temperature link, UL Listed releasing device/mechanical lock assembly. This assembly shall replace the standard fusible link and spring lock clip device. The link shall be activated by duct ambient temperature to permit the damper to close and lock independent of the motor actuator position. Upon normalization of duct ambient temperature the link shall return to its reset position enabling the damper to be fully recycled by the actuator automatically. A manual reset button shall also be acceptable to return damper to its normal position.

5. All combination fire/smoke dampers shall be installed in accordance with the manufacturers UL installation instructions.

6. Electric motor actuators shall be Underwriters Laboratories listed and furnished with all necessary mounting and location hardware from the factory for installation outside of the ductwork unless specifically shown otherwise on the drawings. The actuators shall be (power open/spring closed operation - 120V. A.C.-). The combination fire/smoke dampers shall be furnished with connecting shafts and linkage utilizing not more than one

(1) actuator for single and multiple assembly sizes up to 23 square feet. Smoke damper and fire/smoke damper actuators shall be manufactured by Belimo or approved equal.

7. All smoke dampers shall have fail close operation and shall have a maximum of 15 second open and 15 second close response time.

8. Provide 12-inch x 12-inch (minimum) duct access door at fire/smoke dampers to allow maintenance and visual inspection per NFPA requirements.

E. Where fire, smoke or fire/smoke dampers are above inaccessible ceilings, provide access panel assemblies in ceilings with flush accessible cover. Where smoke detectors are required at dampers, coordinate size, quantity and location of access panels to maintain access to detectors. Coordinate installation of all access panels with Architect prior to installation.

F. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2-inch wide curved blades set at 3/4-inch o.c., supported with bars perpendicular to blades set at 2-inch o.c. and set into side strips suitable for mounting in ductwork. As an option, use Ductmate Prorail, Turning Vane and rail system.

G. Flexible Duct Connections: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement and also capable of absorbing vibrations of connected equipment.

H. Connectors shall comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems" and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems".

1. Indoor installations shall be of a UL 214 Listed, fire-retardant vinyl coated woven nylon or Neoprene coated woven fiberglass fabric. Minimum density of vinyl is 22 ounces/sq. yd. and rated to 180°F. Minimum density of Neoprene 30 ounces/sq. yd and rated to 200°F.

2. Outdoor installations shall be of a UL 214 Listed UV-resistant Hypalon coated woven fiberglass fabric. Minimum density 24 ounces/sq. yd. and rated to 250°F.

3. Connector shall be Ductmate Proflex or approved equal.

I. Duct Damper Access: Where duct balancing dampers are above inaccessible ceilings, provide "Young Regulator" or equal damper extension rods and access panel assemblies in ceilings with flush accessible cover.

J. Provide access doors of adequate size to allow easy access to the equipment that will require maintenance. Provide insulated or acoustical line doors where duct is of the same construction.

K. Systems designed for 3-inch w.g. and less (SMACNA Seal Class B or C) shall utilize hinged, cam or hinged and cam square-framed access door.

L. Systems designed for 4-inch w.g. and above (SMACNA Seal Class A) shall utilize sandwich-type access door. Construct doors in accordance with Figure 2-10 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metals and Flexible" Second Edition.

M. Manufacturer to provide an installed neoprene gasket around perimeter of access door for airtight seal.

N. Acceptable Manufacturers: Ductmate Industries, Inc. or approved equal.

2.5 AIR OUTLETS AND INLETS

A. Diffusers, Registers, and Grilles:

1. General: Except as otherwise indicated, provide manufacturer's standard air diffusers, registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

2. Performance: Provide air diffusers, registers, and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

3. Ceiling and Wall Compatibility: Provide diffusers, registers, and grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling and wall systems which will contain each type of air diffuser, register and grille.

4. Finish: Diffusers, registers and grilles shall have an off-white factory applied finish, unless shown otherwise.

5. Dampers and Accessories: See schedule on drawings for required dampers and accessories.

6. Types: Unless designated herein, provide diffusers, registers, and grilles of type, capacity and with accessories and finishes as listed on schedules and details, shown on drawings.

2.6 LOUVERS

A. General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated and as required for complete installation.

B. Performance: Provide louvers that have 50% minimum free area, and .10-inch maximum pressure drop for each type as listed in manufacturer's current data.

C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T5. Louver shall bear the AMCA Seal. Weld units or use stainless steel fasteners. Louver finish shall be acrodized with color to match building window frames. Provide five (5) year warranty on finish.

E. Louver Screens: On inside face of exterior louvers, provide 1/2-inch square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

F. Blade: Blade shall be 6-inches in depth and of drainable type construction for sizes larger than 24-inches x 24-inches. Louver sizes below 24-inches x 24-inches shall have a 4-inch blade depth of drainable construction.

G. Manufacturer: Provide a Ruskin ELF6375DX (6-inch) or ELF375DX (4-inch) louver or approved equal.

2.7 AIR TERMINALS

A. General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule.

B. Casing: Construct of sheet metal of the following minimum thicknesses:

	Steel	Aluminum
1. Upstream Pressure Side:	24-gage	0.032-inch
2. Downstream Pressure Side:	26-gage	0.025-inch

3. Provide hanger brackets for attachment of supports.

4. Linings: Line inside surfaces of casings with lining material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Provide minimum thickness of 1-inch. Secure lining to prevent delamination, sagging or settling. The terminal units lining material shall be an elastomeric Fibre-fee lining.

   a. Cover liner surfaces and edges with coating or perforated metal.

5. Access: Provide removable panels in casings to permit access to air dampers and other parts requiring service, adjustment or maintenance.

   a. Provide airtight gasket and quarter-turn latches.

6. Leakage: Construct casings such that when subjected to 0.5-in w.g. pressure for low pressure units, and 3.0-in w.g. pressure for high pressure units, total leakage does not exceed 4% of specified air flow capacity with outlets sealed and inlets wide open. Construct air dampers such that when subjected to 6.0-in w.g. inlet pressure with damper closed, total leakage does not exceed 10% of specified air flow capacity.

C. Air Dampers: Construct of materials that cannot corrode, do not require lubrication, nor require periodic servicing. Provide maximum volume dampers, both pressure dependent and pressure compensated, that are calibrated in cfm, factory-adjusted, and marked for specified air capacities. Provide mechanism to vary air volume through damper for minimum to maximum, in response to signal from temperature control system.

D. Hot Water Heating Coils: Provide minimum 2-row heating coil constructed of copper tubes and aluminum fins with galvanized-steel casing.

E. Controls: Provide temperature controls as part of the temperature control package.
   1. Provide the following minimum control items compatible with Control System.

a. Static pressure probes.
b. Air flow cross.

F. Identification: Provide label on each unit indicating Plan Number, cfm range, cfm factory-setting, and calibration curve (if required).

G. Hardware: Provide hardware as detailed and required to complete ceiling system including unit mounting brackets, trim pieces, alignment channels, return air diffusers, dummy diffusers, etc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which air distribution systems will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF AIR FILTERS

A. Install air filters and holding devices of types indicated, and where shown; in accordance with air filter manufacturer's written instructions and with recognized industry practices; to ensure that filters comply with requirements and serve intended purposes.

B. Locate each filter unit accurately in position indicated, in relation to other work. Position unit with sufficient clearance for normal service and maintenance. Anchor filter holding frames securely to substrate.

C. Install air filter gage pressure tips upstream and downstream of filters to indicate air pressure drop through air filter. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level inclined gages if any, for proper readings.

3.3 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3-inches and under; 1% for systems rated over 3-inches) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor. Comply with all SMACNA HVAC Duct Construction Standards.

B. The Contractor shall form and erect all ductwork to avoid joists, beams, pipes, light fixtures, etc., and shall maintain fixed ceiling heights and clearances. Provide all drops, raises or offsets in ductwork as required by conditions at building.

C. All openings for ductwork in new and existing construction shall be provided by the General Contractor; however, it shall be this Contractor's responsibility to properly layout and locate all openings required for the installation of these items. All patching and refinishing shall be done in a manner satisfactory to the Architect.

D. Sealing of Rectangular Ductwork: All transverse joints and longitudinal seams shall conform to SMACNA's Class A sealing requirements as defined on Page 1-8, of the 1995 SMACNA Manual, Second Edition.

E. Flexible Ducts: Maximum installed length (from diffuser or grille to sheet metal ductwork), shall be 3-feet-0-inches.

F. Penetrations: Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on four (4) sides by at least 1-1/2-inch. Fasten duct and substrate.

1. Where ducts pass through fire-rated floors, walls or partitions, provide firestopping between duct and substrate.

3.4 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA Standards and in accordance with recognized industry practices to ensure that products serve intended function.

B. At each branch takeoff of supply, return and exhaust systems provide manual volume damper. Provide additional dampers where indicated on drawings. Dampers shall be at least one (1) gage heavier than ducts in which installed, have stiffened edges, shall operate freely and not rattle in any position. Each damper shall have accessible indicating locking quadrant. For concealed quadrants provide 6-inch diameter hand access opening with cover plate flush with finish surface.

C. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.

D. Install fire and smoke dampers according to the manufacturer's UL Approved printed instructions. Install access door in ductwork per UL and NFPA requirements. Provide approved ductwork access doors on one (1) side of wall.

E. Install fusible links in fire dampers.

3.5 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints as follows:

B. Pressure Classifications Greater Than 3-Inch Water Gage: All transverse joints, longitudinal seams, and duct penetrations.

C. Pressure Classification 2 and 3-Inch Water Gage: All transverse joints and longitudinal seams.

D. Pressure Classification Less than 2-Inch Water Gage: Transverse joints only.

E. Seal externally insulated ducts prior to insulation installation.

3.6 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors in accordance with manufacturer's recommendations.

B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-5 and 2-6.

C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-14 through 2-16.

D. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-17.

3.7 INSTALLATION OF AIR OUTLETS AND INLETS

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Locate diffusers, registers and grilles in center of acoustical ceiling modules.

C. Repair all marred surfaces with manufacturer's touch-up paint.

3.8 INSTALLATION OF LOUVERS

A. General: Install louvers in accordance with manufacturers written instructions and in accordance with recognized industry practices to insure that product serves intended functions.

3.9 HIGH AND MEDIUM PRESSURE DUCT SYSTEM LEAKAGE TEST

A. Each section of high and medium pressure ductwork (systems over 2-inch pressure and 2000 FPM velocity) shall be tested for leakage prior to being insulated. Leakage test shall be in accordance with Chapter 10 of the SMACNA high velocity duct manual and as follows:

B. Test apparatus shall consist of the following:

1. A portable source of high pressure air with pressure and volume control capabilities.

2. A flow measuring device consisting of an orifice assembly with straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be calibrated with its own calibration curve. Pressure and flow readings taken with U-tube manometers.

C. Test Procedure:

1. Test for audible leaks as follows:

a. Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.

b. Start the blower with its control damper closed.

c. Gradually open the inlet damper until the duct pressure reaches 2-inches w.g. in excess of designed duct operating pressure.

d. Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.

2. After all audible leaks have been sealed, the remaining leakage should be measured with the orifice section of the test apparatus as follows:

   a. Start blower and open damper until pressure in duct reaches 2-inches w.g. in excess of designed duct operating pressure and read orifice section flow rate.

   b. Total allowable leakage should not exceed 1% of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.

3.10 INSTALLATION OF AIR TERMINALS

A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

3.11 INSTALLATION OF DUCT MOUNTED SMOKE DETECTORS

A. Detectors shall be furnished and wired by Electrical Contractor. HVAC Contractor shall install the detectors in the metal ductwork maintaining accessibility of the detectors for cleaning and service. Installation shall comply with manufacturer's recommendations.

3.12 CLEANING

A. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris.

B. Clean external surfaces of foreign substances that might cause corrosion, deterioration of the metal or where ductwork is to be painted.

C. Interior surfaces shall be free of dust and debris prior to initial start up.

END OF SECTION

SECTION 23 34 00

FANS AND ROOF CURBS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of fans and accessories work is indicated by drawings and schedules and by requirements of this section.

B. Types of fans and accessories required for this Project include the following:

1. Hoods (Intake and Relief Gravity Ventilators).
2. Pre-Fab Curbs.

C. Provide the following electrical work as work of this section, in compliance with electrical specifications:

1. Fans: Control and interlock wiring between operating controls, indicating devices, unit temperature control panels, and fan starters.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fans of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. UL and NEMA Compliance: Provide electrical components required as part of fans which have been listed and labeled by UL and comply with NEMA Standards.

2. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of fans.

3. UL 762: UL listing for grease removal (kitchen hood fans).

4. ASHRAE Standard 84 for Energy Recovery Ventilators.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for each fan, control, and accessory; including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

A. Handle fans and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.

B. Store fans and components in clean, dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading fans and moving units to final location for installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements.

2.2 GRAVITY VENTILATORS

A. General: Except as otherwise indicated, provide standard, pre-fabricated gravity ventilator units of type and size indicated, modified as necessary to comply with requirements and as required for complete installation.

B. Low Silhouette Box-Type Gravity Ventilators: Provide low silhouette box-type gravity ventilators as indicated, of size and capacity as scheduled.

1. Construction: Design ventilators to be watertight at normal positive pressure conditions, and to withstand wind load of 30 PSF. Provide collecting gutters to collect drainage from baffles and damper gutters.

a. Internal Parts: Hot-dipped galvanized-steel.
b. Exposed Sides: Hot-dipped galvanized-steel, painted.

2. Dampers: Provide integral dampers, constructed for 50% free area outlet when fully open.

a. Provide linkage and 24V damper motor.

3. Bird Screen: Provide removable bird screens, 1/2-inch mesh, 16-gage aluminum or brass wire.

2.3 PREFABRICATED ROOF CURBS

A. General: Provide manufacturer's standard shop-fabricated units, modified if necessary to comply with requirements.

B. Fabricate structural framing for units of structural quality sheet steel (ASTM A 570, Grade 40), formed to profiles indicated or, if not indicated, to manufacturer's standard profiles for coordination with roofing, insulation and deck construction. Include 45 degree cant strips and deck flanges with offsets to accommodate roof insulation. Weld corners and seams to form watertight units.

1. Clean and paint units with manufacturer's standard rust- inhibitive metal primer paint.

C. Reinforce continuous runs of over 3-feet-0-inches length, by inserting welded stiffeners of heavy-gage with flanges as required to provide sufficient rigidity and strength to withstand maximum lateral forces in addition to superimposed vertical loads.

D. Sloping Roof Decks: For deck slopes of 1-inch per foot and more, fabricate support units to form level top edge.

E. Gage and Height: Fabricate units of metal gage and to height above roof surface as indicated here, unless shown elsewhere on drawings.

1. Exhaust Fan and Relief Fan Curbs: 14-gage, 20-inch height.
2. Kitchen Exhaust Fan: 40-inch Vented Curb.
3. Intake Hood Curbs: 14-Gage, 20-inch Height.
4. Relief Hood Curbs: 14-Gage, 20-inch Height.

F. Provide treated wood nailer, not less than 1-5/8-inch thick and of width indicated, but not less than width of support wall assembly. Anchor nailer securely to top of metal frame unit.

G. Provide lumber pressure treated with water-borne preservatives for "above ground" use, complying with AWPB LP-2.

H. Insulate units inside structural support wall with rigid glass fiber insulation board of approximately 3-lb. density and 1-1/2-inch minimum thickness, except as otherwise indicated.

I. Provide support liners where shown, formed of 22-gage galvanized sheet metal, mill phosphatized, flanged at lower edges.

1. Extend support liners through deck construction to coordinate with ductwork below as indicated.

2. Use perforated metal for support liners, with approximately 1000, 3/32-inch diameter holes per sq. ft., to provide sound absorbing surfaces.

3. Provide sound insulation insert for curbs so indicated. Construct of 1-inch thick rigid fiberglass panels secured in galvanized-steel framework, with rounded edges to minimize air flow resistance.

J. Metal Deck Reinforcement: Where indicated as integral part of support units, provide channel-shaped metal deck closure strips to reinforce opening through metal decking. Fabricate strips from 14-gage metal to match metal and finish of curb units, except as otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which fans and accessories are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF HOODS AND ROOF CURBS

A. General: Install hoods and roof curbs per manufacturer's recommendation. Coordinate with Roofing Contractor for proper curb installation.

3.3 FIELD QUALITY CONTROL

A. Testing: Upon completion of installation of fans, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION

SECTION 23 73 13

AIR HANDLERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of air handlers and accessories work is indicated by drawings and schedules and by requirements of this section.

B. Types of air handlers and accessories required for this project include the following:

1. Indoor Draw Thru Air Handler

C. Provide the following electrical work as work of this section, ~~e~~ in compliance with electrical specifications:

1. Air Handlers:

a. Control and interlock wiring between operating controls, indicating devices, unit temperature control panels, and fan starters.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air handlers, packaged heating and cooling units and fans, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central-Station Air Handling Units", display certification symbol on units of certified models.

2. ASHRAE Compliance: Construct refrigerating system of packaged heating and cooling units in accordance with ASHRAE Standard 15 "Safety Code for Mechanical Refrigeration"

3. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE Standard 15 "Safety Code for Mechanical Refrigeration".

4. AMCA Compliance: Test and rate air handling units and fans in accordance with AMCA Standards. Fans shall bear AMCA 300 certified rating seal.

5. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

6. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA Standards.

7. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for air handlers and packaged heating and cooling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance data and parts list for each air handler, packaged heating and cooling unit and accessory; including "troubleshooting" maintenance guide. Include this data and product data in maintenance manual.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handle air handlers, packaged heating and cooling units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.

B. Store air handlers, packaged heating and cooling units and components in clean, dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading air handlers and packaged heating and cooling units and moving units to final location for installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one (1) of the following:

1. Air Handlers:

a. Carrier Air Conditioning
b. McQuay Inc.; Air Conditioning Div.
c. Trane (The) Co.
d. York Div., Borg-Warner Corp.

2.2 AIR HANDLING UNITS

A. General: Provide factory-fabrication and factory-tested air handling units as indicated, of sizes and capacities as scheduled, and as specified herein.

B. Casings: Construct casings of 18-gage minimum mill galvanized steel, designed to withstand specific operating pressures. Provide casing panels and/or access doors that are easily and quickly removable for inspection and access to internal parts.

1. Provide single zone units consisting of fan section, coil section, adjustable fan motor mounting and drain pan.

2. Provide reinforced points of support for either setting or hanging units.

3. Provide drain pan, located under cooling coil section and humidifier section, extensive enough to catch condensate leaving coil at highest catalogued face velocity. Provide at least one (1) drain connection at low point in drain pan.

4. Cover casing and frame with protective finish on both sides.

C. Coils: Provide heating and cooling coils of scheduled capacity, mounted in unit in manner permitting removal.

1. Construct coils with copper tubing primary surface and aluminum secondary surface bonded to tubes by method approved by specified manufacturer. For spray coil application, construct primary and secondary surfaces of copper. Provide chilled water and heating coils with threaded connections. Provide chilled water coils with drain and vent connections. Provide direct expansion coils with solder connections, liquid refrigerant distributors, and connections for gravity oil drainage. Provide steam coil as either single tube standard type or double tube steam distribution type in accordance with schedule. Pitch coils in unit casing for drainage.

D. Coil Sections: Provide common or individual casing for heating and cooling coils as required. Design internal structure of coil section to allow for removal of coils and provide suitable baffles to assure no air bypass around coils. Provide condensate pans and drain connections to cooling coil sections of sufficient size to contain and remove coil condensate. Insulate coil section casings and drain pans as specified in "Insulation" paragraph. For reheat coils, make provisions to allow simultaneous dehumidification and reheating at maximum cooling face velocity catalogued by manufacturer.

E. Fan Sections: Provide forward curved or air foil blade fans specifically designed and suitable for class of service indicated. Provide adjustable motor base, adjusted with mounting bolts, to provide variation in center distance. Provide locking nuts or similar devices, to secure base in proper position. Provide belt driven fans with adjustable pitch pulley permitting fan speed to be varied during the system air balance procedure. Select pulley for mid-point of adjustable range. A fixed sheave shall be furnished and installed after the proper speed is obtained. Design fan shafts so as not to pass through first critical speed when unit comes up to rated RPM. Provide grease lubricated fan bearings with externally accessible fittings for lubrication. Statically and dynamically balance fan assemblies in fan housing after final assembly. Fan and motor assembly shall be internally isolated from unit casing with spring isolators, furnished and installed by unit manufacturer. Fan scroll shall be attached to the unit casing by a flexible canvas duct. Isolators shall be sized for 2-inch static deflectors.

F. Hinged access panels shall be provided for access into the following areas of each air handling unit:

1. Fan section
2. Upstream side of all coils
3. Downstream side of all coils

4. Humidification equipment
5. Air cleaning filters

G. Filter Boxes: Provide filter boxes with either hinged access doors or quickly removable panels, at each end. Provide racks to receive filters in either flat or angle type pattern.

H. Insulation: Insulate unit casing from air entrance to coils, to air outlet from unit, including bypass duct if used. Insulate framing angles exposed to air stream. Securely attach insulation, of sufficient thickness and density to prevent condensation from forming on unit casing. Protect insulation against deterioration from air currents.

1. Provide insulation with fire-retarding characteristics, complying with NFPA 90A. Insulate drain pans as required to prevent condensate formation on unit exterior at ambient conditions to be encountered.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which air handlers and accessories are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF AIR HANDLING UNITS

A. General: Install air handling units, where indicated, in accordance with equipment manufacturer's published installation instructions and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

B. Coordination: Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air handling units with other work.

C. Access: Provide access space around air handling units and packaged units for service as indicated, but in no case less than that recommended by manufacturer.

D. Support: Install floor-mounted air handling units and packaged units on 4-inch high reinforced concrete pad, 4-inches larger on each side than unit base. Provide adequate mounting height to accommodate condensate drain with proper trap seal height.

E. Mounting: Mount air handling units and packaged units on vibration isolators, in accordance with manufacturer's instructions.

F. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of electrical specifications. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

G. Piping Connections: Provide piping, valves, accessories, gages, supports, and flexible connectors as indicated.

H. Duct Connections: Provide ductwork, accessories, and flexible connections as indicated.

I. Grounding: Provide positive equipment ground for air handling unit components.

3.3 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches and abrasions.

B. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets and coils entering air face.

3.4 COMMISSIONING

A. Manufacturer's Field Inspection: Engage a factory-authorized service representative to perform the following:

1. Inspect field assembly of components and installation of central-station air-handling units including piping, ductwork and electrical connections.

2. Prepare a written report on findings and recommended corrective actions.

B. Final Checks before Startup: Perform the following 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, ductwork, and electrical 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 free fan wheel rotation and smooth bearings operations. Reconnect fan drive system, align belts and install belt guards.

5. Lubricate bearings, pulleys, belts and other moving parts with factory-recommended lubricants.

6. Set zone dampers to fully open position for each zone.

7. Set face-and-bypass dampers to full face flow.

8. Set outside-air and return-air mixing dampers to minimum outside-air setting.

9. Comb coil fins for parallel orientation.

10. Install clean filters.

11. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

C. Starting procedures for central-station air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system and fan wheel. Adjust fan to indicated RPM.

a. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.

3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 DEMONSTRATION

A. Engage the services of a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance.

1. Review data in the operation and maintenance manuals.

2. Schedule training with Owner, through Architect, with at least seven (7) days' advance notice.

3.6 EXTRA STOCK

A. Provide one (1) complete extra set of filters for each air handling unit and packaged unit. Install new filters at completion of air handling system work, and prior to testing, adjusting and balancing work. Obtain receipt from Owner that new filters have been installed.

B. Provide one (1) spare set of belts for each belt-driven air handling unit and packaged unit. Obtain receipt from Owner that belts have been received.

END OF SECTION

SECTION 23 81 23

COMPUTER-ROOM AIR-CONDITIONERS

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. Floor-mounted computer-room air conditioners, 6 tons (21 kW) and larger.
2. Floor-mounted computer-room air conditioners, 5 tons (18 kW) and smaller.

1.3 DEFINITION

A. BAS: Building automation system.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Computer-room air conditioners shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
2. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

C. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

D. Color Samples: For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, using input from Installers of the items involved.

B. Seismic Qualification Certificates: For computer-room air conditioners, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set(s) for each belt-driven fan.
2. Filters: One set(s) of filters for each unit.

1.9 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.10 COORDINATION

A. Coordinate layout and installation of computer-room air conditioners 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.

B. Coordinate installation of computer-room air conditioners with computer-room access flooring Installer.

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

D. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Humidifiers: Manufacturer's standard, but not less than three years from date of Substantial Completion.
3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED UNITS 6 TONS (21 kW) AND LARGER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Compu-Aire, Inc.
2. Data Aire Inc.
3. Liebert Corporation.
4. Stulz-ATS.

B. Description: Packaged, factory assembled, pre-wired, and pre-piped; consisting of cabinet, fans, filters, humidifier, and controls.

C. Cabinet and Frame: Welded steel, braced for rigidity, and supporting compressors and other mechanical equipment and fittings.

1. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges, and concealed fastening devices.

2. Insulation: Thermally and acoustically insulate cabinet interior with 1-inch- (25-mm-) thick duct liner.

3. Finish of Interior Surfaces: Surfaces in contact with the air-stream shall comply with requirements in ASHRAE 62.1.

4. Finish of Exterior Surfaces: Baked-on, textured vinyl enamel; color as selected from manufacturer's standard colors.

5. Floor Stand: Welded tubular steel, 12-inches high, with adjustable legs and vibration isolation pads.

D. Supply-Air Fan(s):

1. Double-inlet, forward-curved centrifugal fan(s); statically and dynamically balanced.

2. Drive: V-belt, with steel shaft with self-aligning ball bearings and cast-iron or steel sheaves, variable- and adjustable-pitch motor sheave, minimum of two matched belts, with drive rated at a minimum of two times the nameplate rating of motor.

E. Refrigeration System:

1. Compressors: Semi-hermetic reciprocating; with suction-gas-cooled, 1750-rpm motors; thermal overloads; oil sight glass; suction-line strainer; and reversible oil pumps; with oil strainer, internal motor overload protection, resilient suspension system, crankcase heater, manual-reset high-pressure switch, and pump-down low-pressure switch.

2. Compressors: Hermetic scroll; with oil strainer, internal motor overload protection, resilient suspension system, crankcase heater, manual-reset high-pressure switch, and pump-down low-pressure switch.

3. Refrigeration Circuits: Two; each with hot-gas mufflers, thermal-expansion valve with external equalizer, liquid-line solenoid valve, liquid-line filter-dryer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

4. Refrigerant: R-407C or R-410A.

5. Refrigerant Evaporator Coil: Alternate-row or split-face-circuit, direct-expansion coil of seamless copper tubes expanded into aluminum fins.

a. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir as required if floor drain is not present.

6. Integral, Water-Cooled Refrigerant Condenser: Shell-and-tube type fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII with liquid-line stop valve and head-pressure-actuated, two-way regulating valve. Terminate fluid connections outside cabinet.

a. Cooling Medium: Ethylene Glycol solution.

F. Hydronic Cooling Coil: Seamless copper tubes expanded into aluminum fins with modulating three-way control valve.

1. Cooling Medium: Ethylene Glycol solution.

2. Control Valve: Class 125 body.

a. Maximum Pressure Drop: 3 psig (21 kPa) at design flow rate.

b. Close-Off (Differential) Pressure Rating: 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

3. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir if a floor drain is not present.

G. Remote, Air-Cooled, Glycol-Solution Cooler: Corrosion-resistant cabinet, copper-tube aluminum-fin coil, multiple direct-drive propeller fans with fan guards, and single-phase motors with internal overload protection and integral electric control panel. Control capacity by cycling fans.

1. Disconnect Switch: Non-automatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

H. Glycol-Solution Pump Package: Weatherproof and vented enclosure of enameled, galvanized steel on structural base frame containing two centrifugal pump(s) with mechanical seals; electrical-control cabinet with starters, lead-lag switch, automatic switchover, and alarm light.

1. Piping: Interconnecting piping, to and from remote, air-cooled, glycol-solution cooler, with shutoff valves, flow switches, check valves in pump discharge, unions, and pressurized expansion tank with air purge vent and system-charging connection.

2. Glycol: Inhibited ethylene glycol and water solution mixed 50:50, suitable for operating temperature of minus 40 deg F (minus 40 deg C).

3. Disconnect Switch: Non-automatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

I. Electric-Resistance Heating Coil: Enclosed finned-tube electric elements arranged for minimum of three stages, with thermal safety switches, manual-reset overload protection, and branch-circuit overcurrent protection.

J. Extended-Surface, Disposable, Panel Filter: Pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded-wire grid; enclosed in cardboard frame with 2-inch-(50-mm-) thick, disposable, glass-fiber pre-filter.

1. Thickness: 2 inches (50 mm).

2. Initial Resistance: .35 inches wg (Pa)>.

3. Recommended Final Resistance: 1.0 inches wg (Pa)>.

4. Arrestance (ASHRAE 52.1): 30 percent.

5. Merv (ASHRAE 52.2): 7.

K. Infrared Humidifier: High-intensity quartz lamps mounted above stainless-steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; pre-piped and using condensate water from cooling coils with stainless-steel or brass float-valve mechanism; located in bypass air-stream; with flush-cycle timer and solenoid drain valve.

1. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.

2. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.

3. Drain Cycle: Field-adjustable drain duration and drain interval.

L. Integral Electrical Controls: Unit-mounted electrical enclosure with piano-hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control-circuit transformer.

M. Disconnect Switch: Non-automatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

N. Electronic-Control System: Solid state, with start button, stop button, temporary loss of power indicator, manual-reset circuit breakers, temperature control, humidity control, and monitor panel.

1. Monitor Panel: Backlighted, with no visible indicator lights until operating function is activated; indicators include cooling, humidification, loss of airflow, change filters, high temperature, low temperature, high humidity, low humidity, high head pressure (each compressor), and low suction pressure (each compressor).

2. Temperature- and Humidity-Control Modules: Solid state, plug-in; with adjustable set point, push-to-test calibration check button, and built-in visual indicators to show mode of operation.

3. Location: Behind hinged door in front of unit; isolated from conditioned airstream to allow service while system is operating.

O. Microprocessor-Control System: Continuously monitors operation of process cooling system; continuously displays room temperature and room relative humidity; sounds alarm on system malfunction and simultaneously displays problem. If more than one malfunction occurs, system displays fault in sequence with room temperature and continues to display fault when malfunction is cleared until system is reset.

1. Malfunctions:

a. Power loss.
b. Loss of airflow.
c. Clogged air filter.
d. High room temperature.
e. Low room temperature.
f. High humidity.
g. Low humidity.
h. Smoke/fire.
i. Water under floor.
j. Supply fan overload.
k. Compressor No. 1 - Overload.
l. Compressor No. 1 - Low Pressure.
m. Compressor No. 1 - High Pressure.

n. Compressor No. 2 - Overload.
o. Compressor No. 2 - Low Pressure.
p. Compressor No. 2 - High Pressure.

2. Digital Display:

a. Control power on.
b. Humidifying.
c. Dehumidifying.
d. Compressor No. 1 - Operating.
e. Compressor No. 2 - Operating.
f. Heat operating.
g. Economy cooling.

3. Push buttons shall stop and start process cooling system, silence audible alarm, test indicators, and display room's relative humidity.

4. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms.

a. ASHRAE 135 (BACnet), LonTalk, or Modbus communication interface as appropriate for the Owner's current BAS system. This interface connection shall enable the BAS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the BAS.

2.2 FAN MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

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

3.2 INSTALLATION

A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances. Install according to ARI Guideline B.

B. Computer-Room Air-Conditioner Mounting: Install using restrained spring isolators. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1 inch (25 mm).
2. specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

C. Remote, Air-Cooled, Glycol-Solution Cooler Mounting: Install using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1/4 inch (6 mm).

D. Glycol-Solution Pump Package Mounting: Install using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Water and Drainage Connections: Comply with applicable requirements in Division 22 Section "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

D. Condenser-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Provide shutoff valves in water inlet and outlet piping on water-cooled units.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.

2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

F. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION

SECTION 23 84 13

HUMIDIFIERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of humidifier's work required by this section is indicated on drawings and schedules and by requirements of this section.

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

1. Self-contained steam.

C. Humidifiers furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other HVAC Sections.

D. Provide the following electrical work as work of this section, in compliance with electrical specifications:

1. Control and interlock wiring between operating controls, indicating devices and humidifier control panels.

2. Provide all magnetic starters and electrical contactors.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of humidifiers, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ARI Compliance: Test and rate humidifiers in accordance with ARI 620 "Standard for Self-Contained Humidifiers".

2. ARI Compliance: Install humidifiers in accordance with ARI 630 "Standard for Selection, Installation and Servicing of Humidifiers".

3. UL and NEMA Compliance: Provide electrical components required as part of humidifiers, which are listed and labeled by UL and comply with NEMA Standards.

4. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of humidifiers.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, installation and start-up instructions, and furnished specialties and accessories.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to humidifiers. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance data and parts list for each humidifier, control and accessory; including "Trouble-Shooting" Maintenance Guide. Install this data, product data, shop drawings, and wiring diagrams in Maintenance Manual.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General: Except as otherwise indicated, provide packaged humidifiers and ancillary equipment with manufacturer's standard materials and components as indicated by published product information, designed and constructed by manufacturer and as required for complete installation.

2.2 SELF-CONTAINED STEAM HUMIDIFIERS

A. General: Provide self-contained steam humidifiers as indicated, of size and capacity as scheduled.

B. Steam Generator: Provide electrode type boiler, with cleanable and replaceable electrodes, designed to produce steam at atmospheric pressure, with modulating control.

C. Distribution: Provide stainless steel duct distribution pipes and connecting steam hose.

D. Electrical: Provide factory-wired controls to electrical disconnect switch, requiring external connection for electrical supply and remote humidistat only. Provide indicator lights to show unit status.

E. Cabinet: Provide steel cabinet to house steam generator and controls. Design for wall mounting with hinged lockable door and baked enamel finish. Provide connections for water, drain and electric.

F. Drain Cycle: Provide automatic drain cycle and electronic timer, field adjustable for both drain duration and drain interval.

G. Air Gap: Provide air gap on water fill line in accordance with plumbing code having jurisdiction.

H. Humidistat: Furnish wall mounted solid-state electronic sensor controller (humidistat) capable of full modulation.

I. Accessories: Furnish the following accessories:

1. High Limit Duct Mounted Humidistat.
2. Air Flow Switch.

J. Manufacturer: Subject to compliance with requirements, provide self-contained steam humidifiers of one (1) of the following:

1. Armstrong Machine Works.

2. Pure Steam.
3. Herrmidifier Co., Inc.
4. Pure Humidifier.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION OF HUMIDIFIERS

A. General: Install humidifiers where indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that humidifiers comply with requirements and serve intended purposes.

B. Access: Provide access space around humidifiers for service as indicated, but in no case less than that recommended by manufacturer.

C. Support: Provide supports from substrate for humidifiers as indicated and in accordance with manufacturer's installation instructions.

D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of electrical specifications. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

E. Ductwork Connections: Provide air-tight seal at each penetration of humidifiers into ductwork. Provide access door as recommended by manufacturer for service.

F. Steam Piping Connections: Provide separate valved branch to supply humidifier from top of dripped steam runout.

G. Make-Up Water and Drain Connections: Provide separate valved branch to supply humidifier. Provide backflow prevention device as required by Plumbing Code having jurisdiction.

H. Grounding: Provide electrical equipment ground for electrically-operated humidifiers and components.

3.3 COMMISSIONING

A. Startup Services: Provide the services of a factory-authorized service representative to provide startup service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements of electrical specifications. Do not proceed with startup until wiring installation is acceptable to equipment Installer.

C. Start humidifiers according to manufacturer's instructions.

D. Operate and adjust controls and safeties.

E. Set Humidistat: Verify relative humidity and calibrate as required.

3.4 CLEANING

A. Clean factory-finished surfaces. Repair marred or scratched surfaces with manufacturer's touchup paint.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance.

B. Review data in the Operation and Maintenance Manuals.

C. Schedule training with Owner, through the Architect, with at least seven (7) days' advance notice.

END OF SECTION

SECTION 26 05 00

GENERAL ELECTRICAL

PART 1 - GENERAL

1.1 RESPONSIBILITIES

A. The Bidding Requirements, Conditions of Contract, General Specifications and General Requirements, and this Division shall be binding on the Contractor and shall apply to all electrical work to be completed under this section.

B. The Contractor shall be responsible for the work from the date of his Contract until its acceptance by the Owner and must make good all damages sustained from whatever cause. He shall use proper care and diligence in bracing and securing all parts of the work and shall in all cases judge as to the amount of protection required.

1.2 ORDINANCES, LAWS AND CODES

A. All materials furnished and installed shall comply with subpart 25.6 – American Recovery and Reinvestment Act – Buy American Act – Construction materials.

B. All work shall conform to the rules and regulations of the National Electrical Code, Local Code, "Occupational Safety and Health Act" and the State Fire Marshall's Office. All certificates of approval shall be delivered to the Architect before final payment will be made.

C. Should any change in the drawings and/or specifications be required to conform to the above mentioned laws and ordinances, the Architect shall be notified by the Bidder prior to the Bid Date, that the necessary changes may be completed. After the Bid Date, all work necessary to meet the requirements shall be at Contractor's expense, with no additional cost to the Owner.

D. The Contractor shall pay all fees, permits or taxes for inspections, etc., in connection with the work under this Contract.

1.3 DATA AND MEASUREMENT

A. The data given herein and on the drawings is as exact as could be secured insofar as building construction and existing conditions are concerned. Extreme accuracy is not guaranteed. The drawings and specifications are intended for the assistance of the Contractor in achieving the end result. Exact locations, measurements, distance, levels, etc., will be governed by conditions at the Job Site.

B. The Contractor shall verify that the size of the equipment supplied by the selected manufacturers does not exceed the available mounting space.

C. The Architect reserves the right to change location or size of conduits, outlets, luminaires or other pieces of equipment as may be necessary to avoid conflicts. No extra compensation will be allowed for such changes unless additional cost to the Contractor is caused.

D. The Bidder shall visit the Project Site that he may have knowledge of conditions at the Job Site and adapt his work to such conditions.

1.4 DRAWINGS AND SPECIFICATIONS

A. Anything mentioned in this specification and not shown on the drawings or vice versa shall be of like effect, as shown or mentioned in both. In any case of discrepancy or differences in the figures, drawings or specifications, the Bidder shall promptly report such discrepancies to the Architect who shall make a decision in writing. Any adjustment by the Contractor without this decision shall be at the expense of the Contractor.

1.5 QUALITY OF WORKMANSHIP

A. The Contractor shall give his personal superintendence and direction to the work. He shall also keep a competent foreman or superintendent on the Project.

B. All equipment, controls and junction boxes shall be located for ready access, operation, repair or maintenance.

C. Any additional drawings necessary for the prosecution of the work will be furnished by the Architect as promptly as possible. The Contractor shall request any additional instructions needed and shall do no work without drawings and instructions.

D. Any discrepancies between the Mechanical, Electrical and Architectural Drawings shall be reported to the Architect prior to the Bid Date.

1.6 GUARANTEE

A. This Contractor shall guarantee all materials, workmanship and the successful operation of all apparatus furnished and installed by him for a period of one (1) year from the date of the final acceptance of the whole work, and shall guarantee to repair or replace at his own expense any part of the apparatus which may show defect during that time, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not to carelessness or improper operation. Guarantee period for the replacement shall begin with the date of replacement.

B. The Owner shall notify the Contractor of any failure of any part or parts which occur during the guarantee period.

C. The Contractor shall also guarantee the systems and the apparatus to be working properly to meet all conditions as specified.

1.7 SHOP DRAWINGS

A. Shop Drawings shall be submitted in accordance with the requirements of Paragraph "Shop Drawings" of the General Conditions. The Contractor shall submit Shop Drawings of all fabricated work and equipment to be purchased. Data shall be sufficiently completed to permit evaluation and comparison with specified equipment and material. Each item shall be prepared as a separate submittal, not grouped or bound with other items.

B. All drawings shall bear the Contractor’s stamp of approval and must be dated.

C. Shop Drawings shall include, but not be limited to the following:

1. Luminaires.

2. Lamps.
3. Panelboards.
4. Circuit and Motor Disconnects.
5. Transformers.
6. Engine Generator, Transfer Switch, Auxiliary Equipment.
7. Fire Alarm Systems.
8. Door Alarm System.
9. Sound Systems.
10. Security System.
11. Telecommunication Cabling System.
12. Television Cabling System.
13. Cable Tray.
14. PVC-coated Rigid Galvanized Steel Conduit and Associated Fittings.
15. Fuses.
16. Wiring Devices – Switches, Receptacles, Device Wallplates.
17. Occupancy Sensors.

D. A notation shall be made on each item submitted as to its specified use or description of specific location in the work.

E. None of the preceding items shall be purchased, delivered to the site or installed until the item has been properly submitted in writing and reviewed by the Architect.

F. Submittals shall be made even though the item is exactly as specified.

G. Should the Contractor fail to comply with any of the requirements as stated, the Architect reserves the right to select a full line of materials, appliances and equipment, which shall be final and binding upon the Contractor.

1.8 SUBMITTAL DATA

A. Review of submittal data is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: Dimensions, which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades and the satisfactory performance of his work.

B. Contractor will be limited to one (1) review on a singular piece of equipment.

C. The listing of a manufacturer as "acceptable" does not imply automatic compliance with Contract Documents. It is the sole responsibility of the Contractor to insure that any price quotations received and submittals made are for equipment/systems, which meet or exceed the specifications included herein.

1.9 EQUAL MANUFACTURERS/EQUIPMENT

A. Any requests for manufacturer/equipment to be considered as equal other than as specified herein shall be submitted to the Engineer not less than 10 days prior to Bid Date.

B. Requests for review shall be sufficiently complete to permit evaluation and comparison with specified equipment and material.

1.10 AUTOCAD DRAWING FILE REQUESTS

A. As an instrument of service to aid in Shop Drawing Submittals, Farris Engineering (FE) will provide AutoCAD drawing files upon request. The files will be sent upon return receipt of the "Request for Drawings" agreement signed by an Officer of the requesting firm. FE does not assure that the drawings represent all changes, addenda items, change orders or modifications that may have occurred. The drawings are simply a tool for use in producing shop drawing submittals.

B. The drawing files will be "cleaned-up" by having the FE logo, Professional Engineer seal and all extraneous notes and details removed. FE must be compensated for this additional service by the requesting firm. A minimum fee of $200.00 for up to eight (8) sheets and $25.00 per sheet for each additional requested drawing will be invoiced to the requesting firm once the signed agreement is received.

PART 2 - PRODUCTS

2.1 PROTECTION OF LUMINAIRES AND WARES

A. This Contractor shall apply the necessary protective coverage to luminaires and other equipment to prevent scratches and mars to such equipment as a result of falling objects or work of other trades.

2.2 STORAGE

A. This Contractor shall provide and be responsible for safe storage of his materials and such storage shall not interfere with the work of others or progress of the Project in any manner.

2.3 EQUIPMENT ENCLOSURES

A. Provide enclosures, which mate properly with the equipment to be enclosed and are NEMA rated to suit the atmospheric conditions of the equipment surroundings.

PART 3 - EXECUTION

3.1 COORDINATION

A. Before installing any work, this Contractor shall coordinate the electrical work with all other Contractors on the Project, with the Electric Utility Company and the City Code enforcing department.

B. All electrical work shall be installed in proper sequence and so arranged with other trades that there will be no delay in the proper installation and completion of any part or parts of all piping systems and mechanical equipment.

C. This Contractor shall carefully examine the drawings and shall be responsible for the proper fitting of equipment and conduit as indicated without major alteration. If alterations are required, a detailed drawing of the proposed departure due to actual field conditions or other causes shall be submitted to the Architect for approval.

D. Whenever interferences might occur, before installing any of the work in question, the Electrical Contractor shall consult with other Contractors and shall come to an agreement with them as to the exact location and level of his conduit bus duct, luminaires and/or parts of his installation.

E. Multiwire branch circuits as defined by the National Electrical Code (circuits with common neutral) shall not be used. Exception: Where an equipment manufacturer requires a multiwire branch branch circuit for only one utilization equipment and where all ungrounded conductors of that circuit are opened simultaneously by the branch circuit overcurrent device.

F. A cable raceway type wiring method, installed in exposed or concealed locations near metal-corrugated sheet roof decking, shall be installed and supported so the nearest outer surface of the cable raceway is not less than 6-inches from the nearest surface of the roof decking. Exception: Rigid metal conduit and intermediate metal conduit shall not be required to maintain this clearance.

G. All changes in the work of this Contractor, caused by his neglect to follow these instructions, shall be made at this Contractor's expense.

3.2 DITCHING, EXCAVATION AND BACKFILLING

A. Contractor shall do all excavation required to install conduits and equipment shown on drawings or required for proper operation. Excess excavation below the required level shall be backfilled with earth and thoroughly tamped.

3.3 CONNECTIONS FOR EQUIPMENT

A. Coordinate the hook up of the following equipment with the Contractor required to furnish and install them. See the appropriate sections in the General Construction Work specifications for further information.

Mechanical Equipment
Owner Furnished Equipment

B. Verify fuse and/or circuit breaker requirements for electrical connections to equipment and provide overcurrent devices accordingly.

C. The plans indicate the locations of system devices. The Contract shall include the wiring system required to interconnect the indicated devices to result in a complete, operating system. The interconnecting wiring shall be in conformity with the requirements of the manufacturer of the equipment as well as with other requirements set out herein. The basic wiring method to be employed is indicated herein. The Contractor's Shop Drawing submittal shall indicate the specific routing and type of wireway and the number and type of conductors to be installed.

3.4 WORK IN EXISTING BUILDING

A. Inasmuch as work under this Contract includes adding to in the existing building, it shall be the responsibility of each Bidder to fully inform himself of any and all conditions which influence or are influenced by work contemplated by these specifications and accompanying drawings. The submission of a proposal by any Bidder will be construed as an admission by him that he has examined and is fully familiar with the premises and all conditions thereon and adjacent thereto, and has included in this proposal a proper and adequate amount to cover rearrangement of old work for the proper installation and operation of the new and existing equipment as shown on the drawings specified herein or as required. Such work shall be neatly and properly done.

B. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated or when authorized otherwise in writing by Owner or Architect. Provide

temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate or abandon existing wiring as indicated.

C. The operation of all special systems within the building shall be maintained, including but not limited to fire alarm, telephone, intercom, communication, data, security, emergency call, etc. Provide temporary connections/equipment as necessary for required sequence of construction. Any necessary momentary outages shall be scheduled with the Owner prior to starting such work.

3.5 DEMOLITION AND REMOVAL OF EXISTING EQUIPMENT AND MATERIALS

A. Existing conduits that are made spare by demolition work shall be removed unless concealed in existing construction.

B. All conduits and conductors shown to be reused shall be thoroughly tested and checked for insulation breakdown and continuity.

C. Electrical items must be removed where they interfere with or are not concealed by new construction such as new ceilings, walls, etc.

D. Existing luminaires, outlets, receptacles and other equipment and material shall be relocated, removed, reconnected or left in place as indicated on the drawings. Where an existing device is shown removed from an existing circuit, new wiring shall be provided as required to insure continuity of existing circuit. If existing devices or other electrical items, such as electrically operated equipment interfere with the location of a new partition, relocation of existing equipment, new equipment, etc., the existing items including electrical components of electrically operated equipment shall be disconnected and removed or satisfactorily relocated and reconnected even though not specifically indicated on the drawings. All material removed which is considered salvageable by the Owner and is not specifically designated to be reused on the drawings or not practical to be reused shall remain in the property of the Owner and shall be neatly stockpiled in a specially designated location.

3.6 TEMPORARY WIRING (Existing Electrical Service)

A. This Contractor shall provide temporary power.

B. Temporary power may be derived from the existing electrical service.

C. All materials for the temporary service and wiring may be used and remains the property of the Electrical Contractor.

D. Temporary wiring materials are not to be installed as part of the permanent wiring system.

E. Wiring need not be installed in conduit, but must be adequately installed and protected from mechanical injury to prevent shock.

F. Permanent wiring including feeders, panels, receptacles, etc., may be used as soon as installed.

G. The Electrical Contractor shall bear all installation costs necessary to connect and disconnect the temporary service.

3.7 CLEANING

A. This Contractor shall at all times keep the premises free of all waste or surplus materials, rubbish and debris which is caused by his employees or resulting from his work.

B. After all equipment and luminaires have been installed and building is ready for occupancy, the Electrical Contractor shall remove all stickers, rust stains, labels, temporary covers, plaster marks, paint spots, etc. All foreign matter shall be blown out or flushed out of all conduits, panels, motors, devices, switches, luminaires, etc.

C. Identification plates and trims on all equipment shall be free of paint and polished.

D. The Contractor shall leave the electrical portion of the work in a safe clean and very neat condition ready for operation.

3.8 RECORD DRAWINGS

A. The Contractor shall maintain an up-to-date set of plans and specifications on the Job Site. He shall mark all Addendum Items and any field changes on this set and see that a copy of all changes is furnished to the Architect at the end of the Project.

B. The drawings shall also include as-built conditions such as equipment locations, routing of service entrance and major feeders, etc.

3.9 INSTRUCTION IN OPERATION BOOKS AND SPARE PARTS

A. After all tests and adjustments have been made, the Contractor shall furnish the necessary qualified personnel to place the special systems in continuous operation, during which time he shall provide complete Operating and Maintenance Instructions to the Owner's representative with an outline of instructions in written form. These personnel shall reserve adequate time to instruct an Owner's representative on proper operation (including all phases of the system and each of its component parts).

B. Contractor shall furnish Owner with two (2) sets of all operating instructions, maintenance instruction and spare parts lists of all equipment furnished under this Contract. Lists shall include current unit prices and source of supply for each item of operable equipment.

3.10 FIRESTOPPING

A. Openings around electrical penetrations through fire-resistant rated walls, partitions, floors or ceilings shall be firestopped using listed materials to maintain the fire rating. Installation shall be done in accordance with manufacturer's recommendations. Materials shall be UL Listed and labeled and FM approved for fire ratings consistent with penetrated barriers.

1. Foamed-in-place type firestopping shall only be permitted in concealed-from-view locations. Sealant type firestopping shall be used in exposed-to-view locations.

2. Cable tray, conduit sleeves (2-inch and larger) and similar penetrations of fire-rated walls, floors or ceilings shall be sealed by a method that permits cables to be easily added or removed without damage to the firestopping materials. Products similar to Grace Construction Products Flamesafe Bags, Specified Technologies, Inc. EZ Path Fire Rated Pathway and Wiremold Flamestopper FS Series are acceptable when rated for the

application. Coordinate requirements with product manufacturer and authority having jurisdiction. Foamed in place or sealant type firestopping are not acceptable at these locations.

3.11 TESTS AND ADJUSTMENTS

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

B. During the progress and after completion of the work included under this specification, the Contractor shall make all required tests at his own expense in the presence of the Architect as required hereinafter and by local ordinances, codes, laws and regulations. Such tests shall be in accordance with other sections of this division. The Architect shall be notified five (5) days in advance as to the time when such tests are to be performed that a representative of the Architect may be present.

END OF SECTION

SECTION 26 05 19

WIRES AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of electrical wire and cable work is indicated by drawings and schedules. Wires and cables shall be single, insulated conductors, field-installed in continuous raceways unless specified otherwise.

B. Types of electrical wire, cable and connectors specified in this section include the following:

1. Copper conductors.
2. Tap type connectors.
3. Wirenut connectors.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one (1) of the following (for each type of wire, cable and connector):

1. Wire and Cable:

a. Apex Wire and Cable Corp.
b. American Insulated Wire Corp.
c. American Wire and Cable Co.
d. Belden Div; Cooper Industries.
e. Brand-Rex Div; Pyle National Co.
f. Cerro Wire and Cable Corp.
g. Cleveland Insulated Wire Co.
h. General Cable Corporation.
i. Helix Wire Corporation.
j. Houston Wire
k. Indiana Insulated Wire Inc.
l. Laribee Wire Manufacturing Co., Inc.
m. Madison Wire and Cable Corp.
n. Okonite Co.
o. Pirelli Cable Corp.
p. Radix Wire Co.
q. Rome Cable Corp.
r. Southwire Company.
s. Triangle PWC, Inc.

2. Connectors:

a. AMP, Inc.
b. Appleton Electric Co; Emerson Electric Co.
c. Buchanan Co.

d. Burndy Corporation.
e. Brand-Rex Div. Pyle National Co.
f. Electrical Products Div; Midland-Ross Corp.
g. General Electric Co.
h. Gould, Inc.
i. Ideal Industries, Inc.
j. Leviton Mfg Company.
k. 3M Company
l. O-Z/Gedney Co.
m. Southport Industries Inc.
n. Square D Company.
o. Thomas and Betts Corp.

2.2 WIRES, CABLES AND CONNECTORS

A. General: All reference to size in these specifications or on drawings is for copper conductors. Provide electrical wires, cables and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20°C (68°F).

B. Building Wires: Provide factory-fabricated wires of sizes, ampacity rating, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA Standards.

C. Cables: Provide UL-type factory-fabricated cables of sizes, ampacity ratings, and materials and jacketing/sheathing as indicated for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements, NEC and NEMA Standards.

D. Connectors: Provide UL-type factory-fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA Standards.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, UL and NECA's "Standard of Installation" and in accordance with recognized industry practices.

B. The normal minimum size shall be 12 AWG. All wire No. 10 and smaller to be solid, all No. 8 and larger shall be stranded.

C. All service entrance, feeder and branch circuit wiring shall be type THHN/THWN.

D. Pull conductors simultaneously where more than one (1) is being installed in same raceway.

E. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation. Use of soap will not be permitted as pulling lubricant.

F. Insulation on conductors shall be permanently marked with wire size, insulation type, voltage range and manufacturer's name. The insulation on conductors shall be color coded as follows:

1. 120/208-volt circuit: Phase A - Black; Phase B - Red; Phase C - Blue.
2. 277/480-volt circuit: Phase A - Brown; Phase B - Orange; Phase C - Yellow.

G. The phase conductors shall be tagged and shall remain the same throughout the circuit.

H. Switch legs shall be color coded to distinguish them from Hot or Phase Conductors.

I. Switch legs occurring in the same box or enclosure shall be color coded separately.

J. Exceptions to the color coding as listed above shall be as follows:

1. Wiring for special systems shall be color coded or labeled as required by the manufacturer.

2. On a 4-wire, delta connected secondary where the midpoint of one (1) phase is grounded, the phase conductor having the higher voltage to ground shall be Phase B and shall be color coded orange.

K. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway.

L. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural members and follow surface contours, where possible.

M. Keep conductor splices to minimum.

N. Install splices and taps which possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced.

O. Use splice and tap connectors which are compatible with conductor material.

P. All splices and taps shall be made in outlet, junction and pull boxes. Splices on circuit wiring shall be of the pigtail type using solderless connectors. Larger sizes of conductors requiring uninsulated connectors of the bolt type shall be taped with pressure sensitive vinyl tape.

Q. For branch circuit wiring, conductor fill per conduit run shall not contain more than eight (8) current carrying wires, provided the wire size is derated as required by the National Electrical Code. Conduits containing both circuit switch legs and/or traveler wires may contain more than the number stated above, providing the conduit is of adequate size and the wire size is derated as required by the National Electrical Code. Whenever a 120-volt, single phase branch circuit is over 70-feet in length or a 277-volt, single phase branch circuit is over 150-feet, the conductors shall be increased one (1) size to the first outlet box unless specifically noted otherwise. For special systems conductor fill of conduit is per manufacturers specifications furnished with each system, noted on the drawings or shall be as required by code.

R. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check installed wires and cables with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled.

B. Prior to energization, test wires and cables for electrical continuity and for short-circuits.

C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units and then retest to demonstrate compliance.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of grounding work is indicated by drawings, schedules and as specified herein.

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

1. Solid grounding.

C. Requirements of this section apply to electrical grounding work specified elsewhere in these specifications.

PART 2 - PRODUCTS

2.1 GROUNDING SYSTEMS

A. Materials and Components:

1. General: Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid and additional accessories needed for complete installation. Where more than one type unit meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE and established industry standards for applications indicated.

B. Conductors: Provide copper electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC. All conduits shall contain a minimum of one (1) separate equipment grounding conductor identified and sized according to NEC.

C. Bonding Jumper Braid: Copper braided tape, constructed of 30-gage bare copper wires and properly sized for indicated applications.

D. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gage bare copper wire; 3/4-inch wide, 9-1/2-inches long; 48,250cm. Protect braid with copper bolt hole ends with holes sized for 3/8-inch dia. bolts.

E. Bonding Plates, Connectors, Terminals and Clamps: Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by bonding plate, connector, terminal and clamp manufacturers for indicated applications.

F. Ground Rods and Plates:

1. Ground Rods: Steel with copper welded exterior, 5/8-inch dia. x 8-feet (Unless otherwise noted).

2. Ground Plates: Sheet copper plate, 20-gage x 36-inch x 36-inch, with two (2) cable attachments for 1/0 or 2/0 cables.

G. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type services indicated.

H. Exothermic Welded Connections: Comply with AWS Code for procedures, appearance, and quality of welds; and methods used in correcting welding work. Provide welded connections where grounding conductors connect to underground grounding rods/electrodes.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine areas and conditions under which electrical grounding connections are to be made and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL GROUNDING

A. General: Install electrical grounding systems where shown, in accordance with applicable portions of NEC, with NECA's "Standard of Installation" and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.

B. The equipment grounding conductor shall be connected directly to the equipment grounding screw provided on receptacles.

C. At switch outlets, where self-grounding type switches are installed in metal boxes, the equipment grounding conductor shall be connected directly to the metal box.

D. Where switches installed in non-metallic boxes have metallic cover plates or screws, provide switches with green hexagonal equipment ground screw and connect to the equipment grounding conductor.

E. Coordinate with other electrical work as necessary to interface installation of electrical grounding system with other work.

F. Weld grounding conductors to underground grounding rods/electrodes. (Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable).

G. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms or less, by driving additional ground rods and/or by chemically treating soil encircling ground rod; then retest to demonstrate compliance.

END OF SECTION

SECTION 26 05 29

SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals and associated fastenings.

1. Refer to other Division 26 Sections for additional specific support requirements that may be applicable to specific items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Slotted Metal Angle and U-Channel Systems:

a. Allied Tube & Conduit.
b. American Electric.
c. B-Line Systems, Inc.
d. Cinch Clamp Co., Inc.
e. GS Metals Corp.
f. Haydon Corp.
g. Kin-Line, Inc.
h. Unistrut Diversified Products.

2. Conduit Sealing Bushings:

a. Bridgeport Fittings, Inc.
b. Cooper Industries, Inc.
c. Elliott Electric Mfg. Corp.
d. GS Metals Corp.
e. Killark Electric Mfg. Co.
f. Madison Equipment Co.
g. L.E. Mason Co.
h. O-Z/Gedney.
i. Producto Electric Corp.
j. Raco, Inc.
k. Red Seal Electric Corp.
l. Spring City Electrical Mfg. Co.
m. Thomas & Betts Corp.

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps.

B. Fasteners: Types, materials and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type. Plastic expansion anchors (for conduit 1-inch and smaller only).

2. Toggle Bolts: All steel springhead type.

3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

E. U-Channel Systems: 16-gage steel channels, with 9/16-inch diameter holes, at a minimum of 8-inches on center, in top surface. Provide fittings and accessories that mate and match the U-channel and are of the same manufacturer.

2.4 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves of one (1) of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:

a. 3-inches and smaller: 20-gage.
b. 4-inch to 6-inches: 16-gage.
c. Over 6-inches: 14-gage.

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.

2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four (4). Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.

3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support parallel runs of horizontal raceways together on trapeze-type hangers.

5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

6. Support exposed and concealed raceway within 1-foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.

7. In vertical runs, arrange support so that load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

D. Vertical Conductor Supports: Install simultaneously with installation of conductors.

E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers and other devices.

F. Support sheet metal boxes directly from the building structure or by bar hangers.

G. Sleeves: Install in concrete slabs and walls and all other firerated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL Listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.

H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Holes cut to depth of more than 1-1/2-inch in reinforced concrete beams or to depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25% of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

END OF SECTION

SECTION 26 05 33

RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. All wiring shall be installed in continuous raceways as specified herein except where specifically noted otherwise.

1. When in conformance with the National Electrical Code and other applicable codes and listed for use in return air plenums, low voltage wiring (30-volt or less) may be installed without conduit above accessible ceilings unless noted otherwise. All low voltage wiring at other locations (concealed in walls, above non-accessible ceilings, exposed areas without ceilings, etc.) shall be installed in conduit. All fire alarm system wiring shall be installed in conduit. All cable installed without conduit shall be neatly placed within joist space above ceilings and properly supported. Cable shall not be placed on or supported by ceiling system.

B. Types of raceways in this section include the following:

1. Electrical metallic tubing.
2. Flexible metal conduit.
3. Liquid-tight flexible metal conduit.
4. Rigid metal conduit.
5. Rigid nonmetallic conduit.
6. Surface metal raceways.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements and comply with applicable portions of NEC for raceways.

B. Rigid Steel Conduit: Provide rigid steel, zinc-coated, threaded type conforming to ANSI C80.1 and UL 6. Provide zinc coating fused to inside and outside walls.

1. Rigid Metal Conduit Fittings: Rigid metal conduits shall have threaded couplings when installed in concrete or direct burial in the ground. Other installations in dry locations may be threadless rigid fittings.

2. PVC Externally Coated Rigid Steel Conduit: Provide rigid steel zinc-coated with additional external coating of PVC conforming to ANSI C80.1 and NEMA RN 1.

C. Flexible Metal Conduit: Provide flexible metal conduit conforming to UL 1. Formed from continuous length of spirally wound, interlocked zinc-coated strip steel.

1. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.

   a. Straight Terminal Connectors: One-piece body, female end with clamp and deep slotted machine screw for securing conduit and male threaded end provided with locknut.

   b. 45° or 90° Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit and male threaded end provided with locknut.

D. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit conforming to UL 360; construct of single strip, flexible, continuous, interlocked and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).

1. Liquid-Tight Flexible Metal Conduit Fittings: Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated throat.

E. Electrical Metallic Tubing (EMT): Provide electrical metallic tubing conforming to ANSI C80.3 and UL 797.

1. EMT Fittings: Fittings for EMT shall be steel and may be of the screw or compression type except that in poured concrete the screw type is not acceptable. All EMT connectors shall be of the insulated throat type. Cast or indenter fittings are not acceptable. EMT connectors shall be fastened to box or enclosure with locknuts. Snap-in fittings are not acceptable.

2. Steel EMT connectors with male threads on the locknut and female threads on the connector equal to Cooper Crouse-Hinds Space-Saver connectors may be used in lieu of insulated throat type connectors.

F. Conduit Bodies: Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded-conduit-entrance ends, removable covers, either cast or of galvanized steel and corrosion-resistant screws.

2.2 NONMETALLIC CONDUIT

A. General: Provide nonmetallic conduit and fittings of types, sizes and weights as specified.

B. Rigid Nonmetallic Conduit:

1. Heavy Wall Conduit: Schedule 40, 90 C, UL Rated, construct of polyvinyl chloride and conforming to NEMA TC-2, for direct burial, or normal above ground use, UL Listed.

2. Extra Heavy Wall Conduit: Schedule 80, UL Rated, construct of polyvinyl chloride compound C-200 PVC and UL Listed for direct burial or above ground use.

C. Conduit and Tubing Accessories: Provide conduit and tubing duct accessories of types, sizes, and materials, complying with manufacturers published product information, which mate and match conduit and tubing.

2.3 WIREWAYS

A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps and other components and accessories as required for complete system.

B. Lay-in Wireways: Construct lay-in wireways with hinged covers, in accordance with UL 870 and with components UL Listed, including lengths, connectors and fittings. Select units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors. Construct units to be capable of sealing cover in closed position with sealing wire. Provide wireways with knockouts.

1. Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached that removal is not necessary to utilize the lay-in feature.

2. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

C. Raintight Wireway: Construct raintight lay-in wireways with hinged covers, in accordance with UL 870 and with components UL Listed, including lengths, connectors and fittings. Design units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors. Construct units to be capable of sealing cover in closed position with sealing wire. Provide wireway units with knockouts only in bottom of troughs.

D. Raintight Troughs: Construct in accordance with UL 870, with components UL Listed.

1. Construction: 16-gage galvanized sheet metal parts for 4-inch x 4-inch to 6-inch x 6-inch sections, and 14-gage parts for 8-inch x 8-inch and larger sections. Provide knockouts only in bottom of troughs, with suitable adapters to facilitate attaching to other NEMA 3R enclosures. Do not use gasketing that can rip or tear during installation, or would compromise raintight capability of the trough. Do not use cover screws that will protrude into the trough area and damage wire insulation.

2. Finish: Provide 14-gage and 16-gage galvanized sheet metal parts with corrosion-resistant phosphate primer and baked enamel finish. Plate hardware to prevent corrosion.

E. J.I.C. Wireway: Construct wireway in accordance with UL 870. Manufacture to J.I.C. Standards for Oiltight and Dusttight Lay-in Wireway and to NMTBA Standards for Industrial Control Equipment.

1. Lengths and Fittings: Manufacture from 14-gage steel, provide straight lengths with hinged covers with gasketing. Hold covers closed with external latches. Installation of Knockouts in either lengths or fittings are to be avoided.

2. Connections: Provide wireway that is suitable for "lay-in" conductors and with joint hardware assembly with each piece. Provide gasketed joint assembly, attached in such a manner that it does not have to be removed to utilize the lay-in feature.

3. Finish: Provide sheet metal parts with corrosion resistant phosphate coating and baked enamel finish.

4. Installation: Fasten wireway joint connections with use of slotted hex head screws. Gasket each joint for oil-tight seal where lengths are joined.

PART 3 - EXECUTION

3.1 INSTALLATION OF RACEWAYS

A. General: Install raceways as indicated; in accordance with manufacturer's written installation instructions, and in compliance with NEC and NECA's "Standards of Installation". Install units plumb and level and maintain manufacturer's recommended clearances.

B. Coordinate with other work including wires/cables, boxes and panel work, as necessary to interface installation of electrical raceways and components with other work.

3.2 INSTALLATION OF CONDUITS

A. General: All conduits shall be concealed unless noted otherwise. Install concealed conduits either in walls, slabs or above hung ceilings. In existing work where conduits can not be concealed in finished areas, surface metal raceways shall be used.

1. Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.

2. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

3. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways every 200-feet linear run or wherever structural expansion joints are crossed.

4. Use roughing-in dimensions of electrically operated unit furnished by supplier. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.

B. Conduit Installation: Provide rigid conduit where embedded in concrete on or below grade, in direct contact with earth or fill below slab, wet locations, in sizes larger than 2-inches or installed outdoors. Follow minimum requirements in other areas as follows:

1. Use rigid steel zinc-coated conduit in spaces where exposed below 4-feet-0-inch height in Mechanical Equipment Rooms, Electrical Equipment Rooms, Penthouses and in service splines. Other areas include warehouse spaces where exposed below 18-feet-0-inch height, on floors of crawl spaces and locations subject to mechanical injury.

2. Where acceptable to all authorities having jurisdiction, intermediate metal conduit may be used in lieu of rigid steel conduit in non-hazardous locations when in compliance with NEC.

3. Use PVC coated rigid steel conduit and fittings where installed in corrosive atmosphere. Patch all nicks and scrapes in PVC coating after installing conduit.

4. Use steel zinc-coated EMT for raceway systems except as specifically specified previously, where not allowed by NEC or noted on drawings. Additionally EMT shall not be acceptable below grade, in or under slabs on grade, in wet locations or in sizes larger than 2-inches.

5. Use flexible conduit in movable partitions and from outlet boxes to recessed lighting fixtures in accessible ceilings, and final 24-inches of connection to motors, or control items subject to movement or vibration, and in cells of precast concrete panels. The maximum length for flexible conduit shall not exceed 6-feet.

6. Use liquid-tight flexible conduit where subjected to one (1) or more of the following conditions:

   a. Exterior location.
   b. Moist or humid atmosphere where condensate can be expected to accumulate.
   c. Pump motors.
   d. Corrosive atmosphere.
   e. Subjected to water spray or dripping oil, water or grease.

7. Rigid Non-Metallic Conduits:

   a. Rigid non-metallic conduits may be used below grade or embedded in concrete on or below grade only.

   b. Where acceptable to authority having jurisdiction, rigid non-metallic conduits may be stubbed-up 6-inches above floor where concealed within walls.

   c. Make solvent cemented joints in accordance with recommendations of manufacturer.

   d. Install rigid non-metallic conduits in compliance with NEC, local utility practices, and all other authorities having jurisdiction.

C. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling thread inside the plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6-inches above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.

D. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

E. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200 lb tensile strength. Leave not less than 12-inches of slack at each end of the pull wire.

F. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean. Use temporary closures to prevent foreign matter from entering raceways.

G. Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

H. Size conduits to meet NEC requirements and as shown on drawings or specified herein, except no conduit smaller than 3/4-inch shall be embedded in or below concrete or in masonry walls.

I. Fasten rigid conduit terminations in sheet metal enclosures with locknuts inside and outside enclosure or with threadless rigid box connectors and terminate with bushing.

J. Conduit terminations in wet locations shall be of the threaded hub type or other sealing type fittings UL Listed for use in wet locations.

K. Conduits are not to cross vertical or horizontal openings such as pipe shafts, elevator shafts, ventilating duct openings, etc.

L. Keep conduits a minimum distance of 6-inches from parallel runs of flues, hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.

M. Conduit shall be properly supported as specified herein and as required by NEC.

N. Support riser conduit at each floor level with clamp hangers.

O. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.

P. Complete installation of electrical raceways before starting installation of cables/wires within raceways.

Q. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL Listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

1. Where conduits enter or leave hazardous locations.

2. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.

3. Where required by the NEC.

R. Openings around electrical penetrations through fire-resistant-rated walls, partitions, floors or ceilings shall be firestopped using approved methods to maintain the fire resistance rating.

S. Provide sleeves for conduits passing through foundation or other load bearing walls.

T. Conduits installed underground which extend through the foundation walls shall be sealed to prevent the entrance of moisture through the foundation walls. All conduits extending through the exterior walls of a building in areas below grade shall be provided with a hydrostatic seal such as Link Seal or equal.

U. Concealed Conduits:

1. Conduits in finished areas shall be installed concealed.

2. Metallic raceways installed underground or in floors below grade, or outside are to have conduit threads painted with corrosion inhibiting compound before couplings are assembled. Draw up coupling and conduit sufficiently tight to ensure watertightness.

3. For floors-on-grade, install conduits under concrete slabs.

4. Install underground conduits minimum of 24-inches below finished grade.

5. Rigid steel conduit buried in direct contact with the earth shall be coated with an asphaltum base paint prior to installation and all scratches shall be repainted after installation before backfilling.

V. Conduits in Concrete Slabs:

1. Conduits shall not be installed in concrete slabs without prior approval/direction from the Structural Engineer regarding maximum conduit sizes, minimum cover, locations, etc.

W. Install conduits as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.

X. Exposed Conduits:

1. In unfinished areas such as Janitor Closets, Storage, Mechanical Equipment Rooms, etc., conduit may be run exposed. Prior permission shall be first obtained from the Architect. All exposed conduit shall be installed in a neat manner following the building lines. Horizontal runs shall be close to the ceiling and shall be installed above mechanical piping as much as possible. Single hung conduits shall be supported with strap or rod hangers, wire is not an acceptable hanger. Multiple hung conduits shall be strapped to the channel to hold it in place.

2. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with or at right angles to walls of building.

3. Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.

4. Support exposed conduits by use of hangers, clamps or clips. Support conduits on each side of bends and on spacing not to exceed following: Up to 1-inch: 6-feet-0-inch; 1-1/4-inch and over: 8-feet-0-inch.

5. Run conduits for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.

6. Above requirements for exposed conduits also apply to conduits installed in space above hung ceilings, and in crawl spaces except that spacing of supports for conduits up to 1-inch shall not exceed 8-feet-0-inch.

Y. Conduit Fittings:

1. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.

2. Plastic insulating bushings for terminating rigid conduits smaller than 1-1/4-inch are to have ribbed sides, with smooth upper edges to prevent injury to cable insulation.

3. Install metallic insulated type bushings for terminating rigid conduits 1-1/4-inch and larger. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.

4. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings and plugs to be specifically designed for their particular application.

END OF SECTION

SECTION 26 05 34

ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of electrical box and associated fitting work is indicated by drawings and schedules.

B. Types of electrical boxes and fittings in this section include the following:

1. Outlet boxes.
2. Junction boxes.
3. Pull boxes.
4. Bushings.
5. Locknuts.
6. Knockout closures.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

A. Outlet Boxes: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size and depth to suit each location and application.

1. Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports." Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

B. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.

C. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with steel nuts, bolts, screws and washers.

D. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

B. Surface-mounted device boxes in unfinished areas shall be a minimum of 4-inch square knockout type. Surface-mounted boxes in finished and exterior areas, shall be cast metal, threaded hub similar to Crouse Hinds "FS" or "FD" condulet box.

C. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices and raceway installation work.

D. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.

E. Provide knockout closures to cap unused knockout holes where blanks have been removed.

F. Install electrical boxes in those locations, which ensure ready accessibility to enclosed electrical wiring. Junction boxes shall not be installed above non-accessible ceilings.

G. Avoid installing boxes back-to-back in walls. Provide not less than 24-inch separation.

H. Avoid installing aluminum products in concrete.

I. Position recessed outlet boxes accurately to allow for surface finish thickness.

J. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surfaces.

K. Fasten electrical boxes firmly and rigidly to substrates or structural surfaces to which attached or solidly embed electrical boxes in concrete or masonry. Box support shall be independent of conduit.

L. Provide electrical connections for installed boxes.

M. Subsequent to installation of boxes, protect boxes from construction debris and damage.

3.2 POSITION OF OUTLETS

A. The Electrical Contractor shall consult with Mechanical and General Contractor prior to rough-in outlets and shall set boxes to avoid interference with equipment installation in walls or ceilings.

B. Outlets shall be centered with respect to paneling, trim, furring, etc. Outlets improperly located shall be corrected at Contractor's expenses. Outlets shall be set plumb, secured firmly in place with face of box or plaster ring extending to finished surface or wall, ceiling or floor as the case may be.

C. Washers or bushings shall be installed between recessed box and device strap to make a flush rigid installation of the device installed.

D. The following mounting height schedule is included to assist the Contractor in estimating. All device locations shall be coordinated with Architectural details and elevations. Exact heights shall be obtained from the Project Superintendent at the time of installation or taken from drawings as shown thereon. Heights of device outlets are noted in inches from the finished floor.

Switches	48-inch Top
Receptacles In Janitor Closet Equipment Room, Storage Room, Shop Toilets and Unfinished Areas	48-inch Top
Weatherproof (Exterior)	24-inch Bottom
Others	16-inch Bottom
At Counters and Desk (Unless otherwise indicated)	Bottom 2-inches above backsplash
Fire Alarm Visual Notification Units or Combination Audible/Visible	Bottom of unit 80-inches above finished floor
Fire Alarm Audible Notification Units, Clocks, Speakers, Etc. (Unless otherwise indicated)	Top of unit 6-inches below ceiling or 96- inches (Whichever is lower)
Thermostats, Starters, Speaker Controls, Fire Alarm Manual Stations, Wall Phones, Etc.	48-inch Top

3.3 GROUNDING

A. Upon completion of installation work, ground electrical boxes as required by NEC and other Division 26 Sections.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of electrical identification is indicated by drawings and schedules.

B. Types of electrical identification specified in this section include the following:

1. Buried cable warnings.
2. Electrical power, control and communication conductors.
3. Operational instructions and warnings.
4. Danger signs.
5. Equipment/system identification signs.

C. Refer to Division 01 General Requirements Section, Identification Systems, for equipment and system nameplates and performance data; not work of this section.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION MATERIALS

A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than one (1) single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Plasticized Tags:

1. General: Manufacturer's standard pre-printed or partially pre- printed accident-prevention and operational tags, of plasticized card stock with matte finish suitable for writing, approximately 3-1/4-inch x 5-5/8-inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary working, e.g., DANGER, CAUTION, DO NOT OPERATE.

C. Self-Adhesive Plastic Signs:

1. General: Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.

a. Colors: Unless otherwise indicated or required by governing regulations, provide orange signs with black lettering.

D. Baked Enamel Danger Signs:

1. General: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gage steel; of standard red, black and white graphics; 14-inch x 10-inch size except where 10-inches x 7-inches is the largest size which can be applied where needed, and

except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

E. Engraved Plastic-Laminate Signs:

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

a. Thickness: 1/16-inch, for units up to 20 sq. in. or 8-inch length; 1/8-inch for larger units.

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

F. Underground-Type Plastic Line Marker:

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

G. Marker Tapes:

1. Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.

2. Coordination: Where identification is to be applied to surfaces, which require finish, install identification after completion of painting.

3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Operational Identification and Warnings:

1. General: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

C. Danger Signs:

1. General: In addition to installation of danger signs required by Governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about Project.

a. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 250-volts.

b. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property where instructed by Architect.

D. Equipment/System Identification:

1. General: Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Signs for disconnect switches, motor starters, contactors and similar equipment shall indicate the load served. Except as otherwise indicated, provide single line of text, 1/2-inch high lettering on 1-1/2-inch high sign (2-inch high where two (2) lines are required), white lettering in black field. Lettering for emergency power system components shall be white lettering in red field. Provide text matching terminology and numbering of the Contract Documents and shop drawings. Provide signs for each unit of the following categories of electrical work.

a. Panelboards, electrical cabinets and enclosures.
b. Access panel/doors to electrical facilities.
c. Major electrical switchgear.
d. Disconnect switches.
e. Motor starters.
f. Power transfer equipment.
g. Transformers.
h. Telephone equipment.
i. Fire alarm master station.

2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate.

E. Underground Cable Identification:

1. General: During back-filling/top-soiling of each exterior underground electrical, signal or communication cable, install continuous underground-type plastic line marker, located directly over buried line at 6-inch to 8-inch below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16-inch, install a single line marker.

2. Install line marker for every buried cable, regardless of whether direct buried or protected in conduit.

F. Control Wiring and Cable Identification:

1. All wiring and cabling, including that within factory-fabricated panels and field installed shall be labeled at each end within 2-inches of termination with a cable identifier and other descriptive information. All wiring and cables shall have additional identifiers within 2-inches off exit from the associated raceway.

2. Permanently label or code each point of field terminal strips to show the instrument or item served.

3. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of components does not remove label.

G. Cable/Conductor Identification:

1. General: Apply cable/conductor identification in each box/enclosure/cabinet, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project electrical work.

H. Conduit Identification:

1. General: Where electrical conduit is exposed in spaces with exposed mechanical piping, which is identified by a color-coded method, apply color-coded identification on electrical conduit in a manner similar to piping identification. Except as otherwise indicated, use orange as coded color for conduit.

END OF SECTION

SECTION 26 22 13

TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of transformer work is indicated by drawings and schedules.

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

1. Dry-type transformers.

C. Electrical wiring connections for transformers are specified in applicable Division 26 Sections.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one (1) of the following:

1. General Electric Company.
2. Hevi-Duty Electric Div.
3. Siemens.
4. Square D Co.
5. Cutler-Hammer.

B. The Contractor shall verify that the size of the equipment supplied by the selected manufacturers does not exceed the available mounting space.

2.2 DRY-TYPE TRANSFORMERS

A. General: Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer and as required for complete installation.

B. Dry type transformers shall be NEMA TP1 air cooled, two (2) winding type (fan cooling is not acceptable). KVA ratings and voltages shall be as indicated on the electrical plans or schedule.

C. Single-phase transformers through 15 KVA and 3-phase transformers 6 KVA through 15 KVA shall have two (2) 5% full capacity taps below normal rated primary voltage, all transformers 25 KVA through 300 KVA shall have two (2) 2-1/2% full capacity taps above normal & four (4) 2-1/2% full capacity taps below normal rated primary voltage. Transformers rated 500 KVA shall have two (2) 2-1/2% full capacity taps above normal and two (2) 2-1/2% full capacity taps below normal rated primary voltage.

D. Transformers shall be designed so that under full load the average conductor temperature does not exceed 115°C rise.

E. All insulating materials shall be in accordance with NEMA ST20 Standards for a 220°C UL component recognized insulation system.

F. Transformer coils must be vacuum impregnated with non-hygroscopic thermosetting varnish.

G. The core and coil shall be completely isolated from the enclosure by means of vibration absorbing mounts. There shall be no metal to metal contact between core and coil and the enclosure. On units 500 KVA and smaller, the vibration isolating system shall be so designed as to provide for continual securement of the core and coil unit to the enclosure. Sound isolating systems requiring the removal of all tie down facilities will not be acceptable. Sound levels shall not exceed the following values: 15 to 50 KVA, 45 decibels - 51 KVA through 150 KVA, 50 decibels - 151 KVA to 300 KVA, 55 decibels - 301 - 500 KVA, 60 decibels. Certified test data on individual units shall be submitted at the request of the Engineer without charge.

H. All ventilating openings shall be of the louvered type; expanded metal covering will not be accepted. The base of the transformer shall be constructed of 12-gauge steel minimum with stamped openings for ventilation.

I. Lifting eyes or provisions should be provided on all transformer enclosures, holes in the enclosure requiring the use of spreader bars will not be acceptable. The transformer enclosure shall be degreased, cleaned, and phosphatized with one (1) coat of zinc chromate primer and one (1) coat of baked enamel.

J. The core and coils shall be visibly grounded in the frame of the transformer cubicle by means of a flexible grounding strap of adequate size. A maximum case temperature shall not exceed 35°C rise above a 40°C ambient at its warmest point.

K. Transformers used outdoors or in high moisture areas shall be suitable for such locations.

L. Equipment/System Identification: Provide equipment/system identification nameplates complying with Division 26 Basic Materials and Methods Section Electrical Identification.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine areas and conditions under which power/distribution transformers and ancillary equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until satisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF TRANSFORMERS

A. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, ANSI and IEEE Standards and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate transformer installation work with electrical raceway and wire/cable work, as necessary for proper interface.

C. Transformers shall be mounted on pad-type vibration isolation pads similar to Aeroflex EZ cut pads.

D. Connect transformer units to electrical wiring system; comply with requirements of other Division 26 Sections.

E. All external wiring connections to units shall be made with liquid-tight flexible metal conduit.

F. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B.

G. Transformers shall be floor mounted where possible unless otherwise indicated.

3.3 GROUNDING

A. Provide equipment grounding connections for power/distribution transformers in accordance with the NEC and as indicated on the drawings. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.4 TESTING

A. Prior to energization of transformers, check all accessible connections for compliance with manufacturer's torque tightening specifications.

B. Prior to energization, check circuitry for electrical continuity and for short-circuits.

C. Upon completion of installation of transformers, energize primary circuit at rated voltage and frequency from normal power source and test transformers, including, but not limited to, audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of panelboard and enclosure work, including cabinets and cutout boxes is indicated by drawings and schedules.

B. Types of panelboards and enclosures in this section include the following:

1. Power-distribution panelboards.
2. Lighting and appliance panelboards.

C. Refer to other Division 26 Sections for cable/wire, connectors and electrical raceway work required in conjunction with panelboards and enclosures; not work of this section.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide panelboard products of one (1) of the following:

1. General Electric Company.
2. Siemens.
3. Square D Company.
4. Cutler-Hammer.

2.2 PANELBOARDS

A. General: Except as otherwise indicated, provide panelboards, enclosures and auxiliary components, of types, sizes and ratings indicated, which comply with manufacturer's standard materials; design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

B. Power Distribution Panelboards: Provide circuit breaker type dead-front safety constructed power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types and with arrangement shown; with anti-turn (solderless pressure) type main lug connectors approved for copper or aluminum conductors. Equip with copper bus bars with not less than 98% conductivity and with full-sized neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections. Provide molded-case circuit-breakers for each branch circuit, with toggle handles that indicate when tripped. Where multipole breakers are indicated, provide with common trip so overload on one-pole will trip all poles simultaneously. Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures.

1. Breakers in 240-volt panelboards shall be fully rated and shall have an interrupting capacity of not less than 10,000 -amperes symmetrical.

2. Breakers in 480-volt panelboards shall be fully rated and shall have an interrupting capacity of not less than 14,000 -amperes symmetrical.

3. Circuit Breaker Distribution Panelboards shall be:

General Electric	Spectra Series
Siemens	S4, S5
Square D	I-LINE
Cutler-Hammer	Pow-R-Line 4B

C. Lighting and Appliance Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-turn solderless pressure type lug connectors approved for copper or aluminum conductors; equip with [copper] [tin-plated aluminum] bus bars, full-sized neutral bar, with [bolt-on] [plug-on] type heavy-duty, quick-make, quick-break, single-pole or multi-pole circuit-breakers, as indicated, with toggle handles that indicate when tripped. Multipole breakers shall be provided with a common trip. Provide suitable lugs on neutral bus for each outgoing feeder required; provide bare uninsulated grounding bars suitable for bolting to enclosures [; provide additional isolated ground bus where required].

1. Lighting and Appliance Panelboards shall be type:

	240V Bolt-on	480V Bolt-on
General Electric	AQ	AD, AE
Siemens	S1	S2
Square D	NQOD	NF
Cutler-Hammer	PRL1, PRL2	PRL2, PRL3

2. Breakers in 240-volt panelboards shall be fully rated and shall have an interrupting capacity of not less than 10,000 -amperes symmetrical.

3. Breakers in 480-volt panelboards shall be fully rated and shall have an interrupting capacity of not less than 14,000 -amperes symmetrical.

D. Lighting and Appliance Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, minimum 20-inches wide and 5-3/4-inches deep, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide door in door fronts with adjustable trim clamps, and doors with flush metal locks and keys, all panelboard enclosures keyed alike. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed or surface-mounting as indicated. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed and are NEMA rated to suit the atmospheric conditions of the equipment surroundings.

1. Furnish six (6) spare keys for each type of panelboard cabinet lock.

E. Panelboard Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, cartridge and plug time-delay type fuses, circuit-breakers, ground-fault protection units, etc., as recommended by manufacturer for ratings and applications indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine areas and conditions under which panelboards and enclosures are to be installed and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF PANELBOARDS

A. General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC Standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B or manufacturer's torque requirements when more stringent.

D. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.

E. Provide properly wired electrical connections within enclosures.

F. Provide factory panelboard circuit directory cards upon completion of installation work. Circuit directory cards shall be arranged with even numbered circuits separated by group or card from odd numbered circuits. All circuits, including spares and spaces, shall be labeled. All identification shall be at a minimum typewritten. Hand lettering is not acceptable.

G. Provide four (4) 3/4-inch empty conduits for future from each flush-mounted panelboard to an accessible space above the ceiling in finished rooms or in joist space of unfinished rooms.

H. All wiring within panelboards shall be arranged in a neat and organized manner.

3.3 GROUNDING

A. Provide equipment grounding connections for panelboards as required by NEC and other Division 26 Sections. Tighten connections to comply with tightening torques specified in UL Standards 486A and B to assure permanent and effective grounds.

3.4 FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energization, check panelboards for electrical continuity of circuits and for short-circuits.

D. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units and then retest to demonstrate compliance.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems, which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles.
2. Ground-fault circuit interrupters.
3. Switches.
4. Wallplates.
5. Dimmers.
6. Plugs and connectors.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide wiring devices of one (1) of the following (for each type and rating of wiring device):

1. Arrow Hart
2. Bryant Electric Co.
3. Cooper Wiring Devices
4. Daniel Woodhead Co.
5. Eagle Electric Mfg. Co.
6. General Electric Co.
7. Hubbell Inc.
8. Leviton Mfg Co.
9. Pass and Seymour Inc.

2.2 FABRICATED WIRING DEVICES

A. General: Provide factory-fabricated wiring devices, in types, colors and electrical ratings for applications indicated and which comply with NEMA Standards Pub/No. WD 1. Provide [brown] ivory color devices except as otherwise indicated; color selection to be verified by Contractor with Architect/Engineer. All devices shall be specification grade.

a. Wallplates for emergency devices shall be red.

B. Receptacles:

1. Heavy-Duty Simplex: Provide single heavy-duty self-grounding type receptacles, 2-pole, 3-wire, with green hexagonal equipment ground screw, 20-amperes, 125-volts, with

metal plaster ears; design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-20R unless otherwise indicated.

2. General-Duty Clock Simplex: Provide single general-duty type receptacles, 2-pole, 3-wire, grounding, 15-amperes, 125-volts, with recessed receptacle which permits clock to be mounted flush with wall and cover outlet, with metal hook for supporting clock, side wiring, with NEMA configuration 5-15R.

3. Heavy-Duty Duplex: Provide heavy-duty self-grounding type duplex receptacles, 2-pole, 3-wire, 20-amperes, 125-volts, with green hexagonal equipment ground screw, metal plaster ears, design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-20R unless otherwise indicated.

   a. P & S Plug Tail receptacles with connector built into back of device and separate polycarbonate connector housing with connector leads are acceptable.

   b. Provide orange isolated ground type receptacles where indicated on associated drawings.

   c. Receptacles within independent and assisted living units shall be 15-amp, side-wired, Leviton 'Decora' style.

   d. Provide hospital grade devices where required per NEC and Local Codes.

4. Ground-Fault Interrupters: Provide "feed-thru" type ground-fault circuit interrupters, with heavy-duty duplex receptacles, capable of protecting connected downstream receptacles on single circuit, and of being installed in a 2-3/4-inch deep outlet box without adapter, grounding type UL Rated Class A, Group 1, rated 20-amperes, 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5-milliamperes ground-fault trip level; equip with NEMA configuration 5-20R.

5. Heavy-Duty Duplex (Corrosive Areas): Provide corrosion resistant heavy-duty self-grounding type duplex receptacles (Daniel Woodhead or equal), 2-pole, 3-wire, 20-amperes, 125-volts, with green hexagonal equipment ground screw. All metal parts shall be stainless steel or plated copper alloy. The housing shall be impact resistant and the faceplate shall be yellow nylon.

C. Plugs and Connectors:

1. Plugs and Connectors: Provide plugs and connectors with required amperage ratings, voltage ratings and NEMA configurations, which are designed to suit the atmospheric conditions of the equipment surroundings. All plugs and connectors shall be manufactured by Daniel Woodhead Company or approved equal by one (1) of the following manufacturers:

   a. Hubbell Inc.
   b. Pass and Seymour Inc.

D. Switches:

1. General: Switches shall be provided as specified in this section. Additional features such, as key operator, rocker and lighted toggle shall be provided where indicated on the drawings.

2. Single-Pole: Provide heavy-duty flush single-pole AC quiet, self-grounding type switches, 20-amperes, 120/277-volts, with mounting yoke insulated from mechanism, equip with plaster ears, toggle switch handle, and side-wired screw terminals.

3. Double Pole: Provide heavy-duty flush double-pole AC quiet, self-grounding type switches, 20-amperes, 120/277-volts, with mounting yoke insulated from mechanism, equip with plaster ears, toggle switch handles and side-wired screw terminals.

4. Three-Way: Provide heavy-duty flush 3-way AC quiet, self-grounding type switches, 20-amperes, 120/277-volts, with mounting yoke insulated from mechanism, equip with plaster ears, toggle switch handles and side-wired screw terminals.

5. Four-Way: Provide heavy-duty flush 4-way AC quiet, self-grounding type switches, 20-amperes, 120/277-volts, with mounting yoke insulated from mechanism, equip with plaster ears, toggle switch handles and side-wired screw terminals.

E. Fluorescent Dimming Switches: Provide vertical slide dimming switch compatible with ballast being controlled.

F. Incandescent Dimming Switches: Provide Lutron Nova "T" Series dimming switch.

2.3 WIRING DEVICE ACCESSORIES

A. Wallplates: Provide wallplates for single and combination wiring devices, of types, sizes and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates; wallplates colored to match wiring devices except as noted below. Provide plates possessing the following additional construction features:

1. Finished Areas:

Material and Finish:	0.04-inch thick, type 302 satin finished stainless steel

2. Unfinished Areas:

Material and Finish:	Steel plate, galvanized.

3. Surface-mounted boxes in unfinished areas shall be furnished with 4-inch square raised covers, with openings to fit device or devices to be installed.

B. Furnish non-metallic weatherproof covers for receptacle installed outdoors, in wet locations or shown as weatherproof. Provide in-use weatherproof covers where required per NEC.

C. Finish plates provided for switches controlling exhaust fans shall be stainless steel and engraved as follows "EXH FAN" in 1/4-inch high black filled letters.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes, which are clean; free from excess building materials, dirt and debris.

D. Install wallplates after painting work is completed.

E. The continuity of branch circuit conductors shall not depend on device connections such as lampholders, receptacles, etc. where the removal of the device would interrupt the continuity. Branch circuit conductors shall be spliced with jumpers to connect the device.

F. Connections of wire to devices shall be screw tightened (except devices with built-in connector/leads). Connections using only spring pressure are not acceptable.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B. Use properly scaled torque indicating hand tool.

H. All switches and receptacles with exposed terminals shall be wrapped with insulating tape equal to Scotch No. 33 such that no live parts are left exposed.

3.2 PROTECTION OF WALLPLATES AND RECEPTACLES

A. Upon installation of wallplates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items, which have been damaged, including those burned and scored by faulty plugs and those, which are not clean and free from paint, dirt and debris.

3.3 GROUNDING

A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

3.4 TESTING

A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of fuse work is indicated by drawings and schedules.

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

1. Class RK1 time-delay.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one (1) of the following:

1. Bussman Div; McGraw-Edison Co.
2. Littelfuse Co.
3. Gould Shawmut.

B. Fuse types listed below are for Bussman Co. Fuses by Littelfuse Co. or Gould Shawmut shall be equal to types indicated.

2.2 FUSES

A. General: Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time/current and peak let-through current characteristics indicated, which comply with manufacturer's standard design, materials and construction in accordance with published product information, and with industry standards and configurations.

B. Class RK1 Time-Delay Fuses: Provide UL Class RK1 time-delay fuses rated 250V (Type LPN-RK) for voltages under 250V and 600V (Type LPS-RK) for voltages 250-600V, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for sizes 100- through 600-amperes.

PART 3 - EXECUTION

3.1 INSTALLATION OF FUSES

A. Install fuses as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA Standards for installation of fuses.

B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of fuses with other work.

C. Install fuses in fused switches, if any.

D. Short-circuit protection dual-element fuses installed in individual motor circuits with separate overload protection shall be sized at 150% of motor nameplate current rating or the next standard fuse size. Where excessive ambient temperature, high inertia motor loads or frequent "on-off" cycling requires larger fuses, consult the electrical engineer. Use fuse reducers where fuse gaps are larger than fuse dimension.

E. All fuse sizes shall be coordinated with manufacturer's requirements for each unit of equipment to be connected.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of fusible devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units and then demonstrate compliance with requirements.

END OF SECTION

SECTION 26 28 16

CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of circuit and motor disconnect switch work is indicated on drawings and schedules.

B. Types of circuit and motor disconnect switches in this section include the following:

1. Equipment disconnects.
2. Appliance disconnects.
3. Motor-circuit disconnects.

C. Wires/cables, raceways and electrical boxes and fittings required in connection with circuit and motor disconnect work are specified in other Division 26 Sections.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide circuit and motor disconnects of one (1) of the following:

1. General Electric Co.
2. Siemens.
3. Square D Company.
4. Cutler-Hammer.

2.2 DISCONNECT SWITCHES

A. General-Duty Disconnect Switches: For switches rated less than 100-amps provide surface-mounted, general-duty type, sheet-steel enclosed switches, of types, sizes and electrical characteristics indicated; rated for system voltage, 60 Hz, with required number of poles and solid neutral incorporating spring assisted, quick-make, quick-break switches. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable and is capable of being padlocked in OFF position. Construct current carrying parts of high-conductivity copper, with silver-tungsten type switch contacts and positive pressure type reinforced fuse clips where fusing is required. The enclosure shall be NEMA rated to suit the atmospheric conditions of the equipment surroundings and of the manufacturer's standard finish. When used as service disconnect, provide with UL markings indicating "suitable for use as service equipment".

B. Heavy-Duty Disconnect Switches: For switches rated 100-amps or greater provide surface-mounted, heavy-duty type, sheet-steel enclosed switches, of types, sizes and electrical characteristics indicated; rated for system voltage 60 Hz, with required number of poles and solid neutral incorporating quick-make, quick-break type switches. Equip with operating handle which is integral part of enclosure base and whose position is easily recognizable, and is padlockable in OFF position; construct current carrying parts of high-conductivity copper, with silver-tungsten type switch contacts, and positive pressure type reinforced fuse clips where fusing is required.

The enclosure shall be NEMA rated to suit the atmospheric conditions of the equipment surroundings and of the manufacturer's standard finish. When used as service disconnect, provide with UL markings indicating "suitable for use as service equipment".

C. Motor-circuit disconnect switches must be HP rated.

D. Fuses: Provide fuses for disconnect switches, as recommended by switch manufacturer, of classes, types and ratings needed to fulfill electrical requirements for service indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES

A. Install circuit and motor disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA and NECA's "Standard of Installation" and in accordance with recognized industry practices.

B. Coordinate motor and circuit disconnect switch installation work with electrical raceway work, location of equipment and as necessary for proper interface. Provide U-channel supports from floor and/or structure where required to mount disconnects at free-standing equipment.

C. Install disconnect switches used with motor-driven appliances, and motors and controllers within sight of controller position for motors greater than 1/8 HP.

3.2 GROUNDING

A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground as required by NEC and in Grounding Section of Division 16.

3.3 FIELD QUALITY CONTROL

A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at Project Site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest.

END OF SECTION

SECTION 26 32 13

ENGINE GENERATORS

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 packaged engine-generator sets for standby power supply with the following features:

1. Diesel engine.
2. Unit-mounted cooling system.
3. Remote-mounting control and monitoring.
4. Performance requirements for sensitive loads.
5. Load banks.
6. Outdoor enclosure.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. LP: Liquid petroleum.

1.4 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

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. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.

4. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that day tank, engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For installer, manufacturer and testing agency.

E. Source quality-control test reports.

1. Certified summary of prototype-unit test report.

2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.

4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.

5. Report of sound generation.

6. Report of exhaust emissions showing compliance with applicable regulations.

7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.

2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. 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.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

J. Noise Emission: Comply with applicable state and local government requirements for maximum noise level due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than two weeks in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Owner's written permission.

B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 40 to plus 40 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

1.7 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Division 07 Section "Roof Accessories."

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Caterpillar; Engine Div.
2. Kohler Co.; Generator Division.
3. Magnetek, Inc.
4. Onan/Cummins Power Generation; Industrial Business Group.
5. Spectrum Detroit Diesel.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated.

2. Output Connections: Three-phase, four-wire.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.

3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

8. Start Time: Comply with NFPA 110, Type 10, system requirements.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

   a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.

3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.

4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load

5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.

7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

   a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Fuel oil, Grade DF-2.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Adjustable isochronous, with speed sensing.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

   a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.

   b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Muffler/Silencer: Industrial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 12 dB at 500 Hz.

2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 87 dBA or less.

J. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 12-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.

2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: 60 seconds.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.

5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range

specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.

7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

   a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

   b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

   c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

   d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

   e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

   f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Pad Mounted Tank: Tank provided by the Base. The contractor shall acquire the tank from the Base, move it to the site, clean and provide new components to comply with UL 142. The tank is a freestanding, factory-fabricated 1000 gallon fuel tank manufactured by ConVault. The following features are required to be added:

   1. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.

   2. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.

   3. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.

4. High-Level Alarm Sensor: Liquid-level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.

5. Piping Connections: Install fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.

6. Redundant High-Level Fuel Shutoff: Actuated by high-level alarm sensor in day tank to operate a separate motor device that disconnects day-tank pump motor. Sensor shall signal solenoid valve, located in fuel suction line between fuel storage tank and day tank, to close. Both actions shall remain in shutoff state until manually reset. Shutoff action shall initiate an alarm signal to control panel but shall not shut down engine-generator set.

C. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:

1. Tank level indicator.

2. Capacity: Fuel for two hours' continuous operation at 100 percent rated power output.

3. Vandal-resistant fill cap.

4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel.

E. Indicating and Protective Devices and Controls:

1. AC voltmeter.

2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Fuel tank derangement alarm.
11. Fuel tank high-level shutdown of fuel supply alarm.
12. Generator overload.

F. Indicating and Protective Devices and Controls:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Generator overload.

G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

H. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."

I. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil, low-pressure prealarm.
7. Fuel tank, low-fuel level.

8. Low coolant level.

J. Remote Alarm Annunciator: An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

K. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.

2. Trip Rating: Matched to generator rating.

3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.

2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.

3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.

4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). The enclosure shall be designed to allow full load operation of the engine generator system and all of its accessories and shall be sized for the exact unit being installed. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure. The enclosure shall be as manufactured by D.T.S., Inc., or approved equal

B. Description: Prefabricated or pre-engineered walk-in enclosure with the following features:

1. Construction: Galvanized-steel, metal-clad, integral structural-steel-framed building. The enclosure shall be of the welded and bolted design, with all fabricated steel parts conforming to ASTM 569, specification C-1018, and all structural steel conforming to ASTM A36. No external fasteners allowing corrosion to form will be allowed. All parts are to be individually prepped and primed prior to assembly. Factory paint generator enclosure to match adjacent building color. Existing color is approximately beige but final color shall be field verified and submitted to the Owner with the shop drawings.

2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.

3. Space Heater: Thermostatically controlled and sized to prevent condensation.

4. Louvers: Motorized, equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.

5. Hinged Doors: Adequate doors shall be installed for sufficient access to the generator set and all accessories. Doors shall include steel hinges with brass pins, rain rail moldings above all door openings, recessed, keyed, chrome plated handles with positive rod locking assemblies, and be fully weather-stripped.

6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.

7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.

8. Muffler Location: Within enclosure. The engine generator set supplier shall ship the silencer and flex to the enclosure manufacturer for mounting.

9. Ductwork: The installer of the genset shall install a galvanized air discharge duct, with flexible section, between the engine radiator and the exhaust louver.

C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

D. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.

2. DC lighting system for operation when remote source and generator are both unavailable.

E. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.9 MOTORS

A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.10 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.

2. Full load run.

3. Maximum power.

4. Voltage regulation.

5. Transient and steady-state governing.

6. Single-step load pickup.

7. Safety shutdown.

8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

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

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch (25 mm) on 4-inch (100-mm) high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."

1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

D. Connect fuel piping to engines with a gate valve and union and flexible connector.

1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Division 23 Section "Facility Fuel-Oil Piping."

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Optional NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.

3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.

b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.

c. Verify acceptance of charge for each element of the battery after discharge.

d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.

7. Exhaust Emissions Test: Comply with applicable government test criteria.

8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at locations 25' from the enclosure, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

K. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus

connection. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.

2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 36 00

TRANSFER SWITCHES

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 transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.
2. Bypass/isolation switches.
3. Remote annunciation systems.
4. Remote annunciation and control systems.

B. Related Sections include the following:

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

C. Qualification Data: For manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain automatic transfer switches, remote annunciator and control panels through one source from a single manufacturer.

D. 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.

E. Comply with NEMA ICS 1.

F. Comply with NFPA 70.

G. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Owner no fewer than two weeks in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Owner's written permission.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Contactor Transfer Switches:

    a. Caterpillar; Engine Div.
    b. Emerson; ASCO Power Technologies, LP.
    c. GE Zenith Controls.
    d. Kohler Power Systems; Generator Division.
    e. Onan/Cummins Power Generation; Industrial Business Group.
    f. Spectrum Detroit Diesel.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

2. Switch Action: Double throw; mechanically held in both directions.

3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Provide neutral pole switched simultaneously with phase poles.

H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

I. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

J. Battery Charger: For generator starting batteries.

1. Float type rated 10 A.
2. Ammeter to display charging current.
3. Fused ac inputs and dc outputs.

K. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.

2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

M. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

B. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

D. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

F. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

G. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.

H. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulate normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.

7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

   a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

   b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.

12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

    b. Push-button programming control with digital display of settings.

    c. Integral battery operation of time switch when normal control power is not available.

2.4 BYPASS/ISOLATION SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.

2. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.

3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.

4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.

5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.

6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.

7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.5 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Include the following functions for indicated transfer switches:

1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

2. Indication of switch position.

3. Indication of switch in test mode.

4. Indication of failure of digital communication link.

5. Key-switch or user-code access to control functions of panel.

6. Control of switch-test initiation.

7. Control of switch operation in either direction.

8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

1. Controls and indicating lights grouped together for each transfer switch.

2. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.

3. Digital Communication Capability: Matched to that of transfer switches supervised.

4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.6 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

D. Identify components according to Division 26 Section "Identification for Electrical Systems."

E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.

    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

    c. Verify that manual transfer warnings are properly placed.

    d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

    b. Simulate loss of phase-to-ground voltage for each phase of normal source.

    c. Verify time-delay settings.

    d. Verify pickup and dropout voltages by data readout or inspection of control settings.

    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

    f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.

    g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

    a. Verify grounding connections and locations and ratings of sensors.

C. Testing Agency's Tests and Inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   a. Check for electrical continuity of circuits and for short circuits.

   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

   c. Verify that manual transfer warnings are properly placed.

   d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

   b. Simulate loss of phase-to-ground voltage for each phase of normal source.

   c. Verify time-delay settings.

   d. Verify pickup and dropout voltages by data readout or inspection of control settings.

   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

   f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.

   g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

   a. Verify grounding connections and locations and ratings of sensors.

D. Coordinate tests with tests of generator and run them concurrently.

E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

F. Remove and replace malfunctioning units and retest as specified above.

G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 26 51 13

LUMINAIRES

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of luminaire work is indicated by drawings and schedules.

B. Types of luminaires in this section include the following:

1. High-intensity-discharge (HID).
2. Fluorescent.
3. Incandescent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: The type and manufacturer of all luminaires shall be as indicated on the luminaire schedule and drawings.

2.2 LUMINAIRES

A. General: Provide luminaires, of sizes, types and ratings indicated; complete with, but not necessarily limited to, housings, lamps, ballasts, starters and wiring.

B. All recessed incandescent, fluorescent and H.I.D. luminaires shall be provided with rubber or fiberglass gaskets or of equivalent material to prevent light leaks around flush trim. Luminaires shall be provided with proper thermal protection as required for surrounding environment. Exterior luminaires shall be furnished with weatherproof, neoprene gaskets for outdoor installations.

C. On fluorescent troffers, all acrylic lenses shall be not less than .125-inch thick nominal.

D. No labels on luminaires shall be placed where same will be conspicuous or where same will mar the appearance of the units. The complete units and all components for fluorescent, HID and incandescent luminaires shall bear the Underwriter's Laboratories, Inc., label.

E. All fixture and pole finishes shall be factory applied unless specifically noted otherwise.

F. Fluorescent-Lamp Ballasts: Each fluorescent fixture shall be equipped with an electronic ballast. (See drawings for additional requirements).

G. All ballasts shall have ratings suitable for the atmosphere for which they are to be installed. Luminaires installed in low ambient temperature areas shall have ballasts specifically designed for low temperature starting.

H. Linear fluorescent lamps shall be low mercury TCLP compliant.

I. Provide factory installed integral disconnecting means for fluorescent light luminaires per 2008 NEC article 410.73C (G). Note that exception No. 4 and exception No. 5 will not be accepted.

2.3 LUMINAIRE TYPES

A. General: The luminaire types are designated by letters (A, B, C, etc.) near each outlet and refer to the description as listed in the Luminaire Schedule.

B. All lamps shall be of type specified on the Luminaire Schedule. This Contractor shall furnish lamps for all luminaires as shown on the plans and Luminaire schedule. These lamps shall be new at the time of building acceptance by the Owner. Any lamps used for construction lighting shall be replaced prior to acceptance.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which luminaires are to be installed and substrate which will support luminaires. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF LUMINAIRES

A. Install luminaires at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA Standards and with recognized industry practices to ensure that luminaires fulfill requirements.

B. Coordinate with other electrical work as appropriate to properly interface installation of luminaires with other work.

C. Where recessed luminaires are specified, Contractor shall provide plaster frames or other framing devices to the Ceiling Contractor prior to the installation of the luminaires and shall be responsible to see that the proper luminaires are furnished for the specific ceiling used.

D. Where suspended ceilings are supported on steel angle or channel construction, outlets and luminaires shall be supported on members attached to the angle of channel framework. In no case shall any fixture be hung from plaster, plasterboard, acoustic or insulating materials.

E. Where poles are used, fasten luminaires securely to poles; and ensure that poles are plumb.

F. Where the drawings indicate ballasts/lamps to be separately switched, the lamps within luminaire shall be wired with the outermost lamps on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled. The switch nearest the door shall control the outermost lamps.

3.3 ADJUSTING AND CLEANING

A. Clean luminaires of dirt and debris upon completion of installation.

B. Protect installed luminaires from damage during construction period.

3.4 FIELD QUALITY CONTROL

A. Upon completion of installation of luminaires, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where

possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.5 GROUNDING

A. Provide equipment grounding connections for luminaires as required by NEC and other Division 26 Sections. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

END OF SECTION

SECTION 28 31 10

FIRE ALARM SYSTEM - EXISTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The items of equipment furnished under this specification shall be listed as a product of a single Fire Alarm manufacturer under the appropriate category by Underwriters Laboratories and shall meet the applicable requirements of NFPA Standard 72, Life Safety Code 101, National Electric Code as well as those standards set by the authorities having jurisdiction. The system controls shall be listed under UL Standard 864 (Control Units). In addition, the system controls shall be UL Listed for Power Limited Applications per NEC. All circuits must be marked in accordance with NEC. The Fire Alarm and detection equipment shall not be modified or installed to alter or void the Underwriters Laboratories label or listing.

B. Extent of fire alarm system work is indicated by drawings.

C. Provide power connections, detection devices, etc., where auxiliary equipment is required, such as remote power supplies, voice annunciation panels and other equipment necessary for a complete and operating system. Where the fire alarm control panel is shown connected to an emergency power system, all auxiliary equipment shall also be connected to the emergency power system.

1.2 QUALITY ASSURANCE

A. Submit shop drawings and product data to the Architect-Engineer in accordance with the General Conditions and General Requirements. Shop drawings shall include the following:

1. Complete descriptive product data including UL Listing for all system components and detailed manufacturer's drawings on the: Manual Fire Alarm Station, Automatic Fire Detection Devices, Alarm Signaling Devices, Wiring and Cable, etc.

2. Layout drawings showing the exact location of all Fire Alarm equipment and the interconnection between the devices.

3. Certification by the manufacturer that the battery installation meets the operating requirements specified herein.

B. All Submittal data on this system must be approved by the State Fire Marshal and/or the authority having jurisdiction before it is submitted to the Architect for approval.

C. The Contractor shall furnish to the Owner, upon final acceptance of the system, four (4) sets of written Operating and Maintenance Instructions which shall include copies of all designated approved shop drawings, wiring diagrams, layout drawings and installation and operating instructions.

1.3 EXISTING SYSTEM COORDINATION

A. All fire alarm work is to be made a part of the existing non-addressable Simplex fire alarm system. The Contractor shall verify existing equipment and shall provide a new fire alarm control panel to

the existing fire alarm control panel and auxiliary equipment as specified herein and as necessary for a complete operating system.

1.4 SYSTEM OPERATION

A. Activation of any manual Fire Alarm station, verified smoke detector, duct mounted smoke detector, heat detector, sprinkler system, waterflow switch or any other automatic alarm initiating device, shall provide the following automatic operation:

1. An alarm shall be displayed on the 80 character LCD display. The top line of 40 characters shall be the custom point label and the second line shall be the device type identifier and point status indicator. The custom point label shall identify location of the device. The nomenclature used to describe the device location shall be coordinated with the Owner and shall correspond to zone indication plaque nomenclature. The system alarm red LED shall flash on the Control Panel and remote annunciator until the alarm has been acknowledged at the Control Panel. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the Control Panel. The LCD display shall show the new alarm information.

2. All audible alarm indicating devices shall sound a uniform code 3 temporal pattern and all visual devices shall activate and have the flash rate synchronized until silenced at the Fire Alarm Control Panel or remote annunciator. The system will include provisions for silencing the signaling devices, allowing for re-initiation following a subsequent alarm, but only after the signaling devices have operated initially for not less than three (3) minutes. (The inhibit feature shall be adjustable from 0-5 minutes). Systems that do not have resound capabilities will not be acceptable.

3. All circuits of doors normally held open by door control devices shall release after a five (5) second delay.

4. A supervised signal to notify the Local Fire Department or an approved central station shall be activated.

5. All air handling units over 2,000 CFM shall deactivate and all smoke and fire/smoke dampers shall close.

6. Light an alarm indicator lamp on smoke detectors which have initiated an alarm.

B. The activation of any standpipe or sprinkler valve tamper switch shall activate a distinctive system supervisory audible signal and illuminate a distinctive "Sprinkler Valve Supervisory Tamper" LED at the Control Panel and the Remote Annunciators. Differentiation between valve tamper activation opens and/or grounds on fire alarm initiation circuit wiring shall be provided. Activating the Alarm Silence Switch will silence the supervisory audible signal while maintaining the "Sprinkler Valve Supervisory Tamper" LED on indicating that the tamper contact is still in the off-normal state. Restoring the valve to the normal position shall cause the "Sprinkler Supervisory Tamper" LED to extinguish thus indicating restoration to normal position.

C. The System Control Panel must be capable of communicating with the types of addressable devices specified below. The location of addressable devices will be selected along with conventional devices to optimize the system layout in order to provide the level of protection, zone identification and control as shown on the drawings.

D. The system shall have provisions for disabling and enabling all addressable devices, monitoring, signaling and control circuits individually for maintenance and testing purposes.

E. Alarm and trouble conditions shall be immediately displayed on the Control Panel from Alphanumeric LCD display. If more than one (1) alarm or trouble is in the system, the operator may scroll to display new alarms.

F. A manual evacuation (drill) switch shall be provided to operate the systems alarm indicating devices. Other control circuits shall not be activated. However, an alarm shall be processed as described previously.

G. The Control Panel shall include a system testing capability to help ensure that zoning and supervision have been maintained throughout the system. The actuation of the enable walk test program at the Control Panel shall activate the "Walk-Test" mode of the system which shall cause the following to occur:

1. The city connection circuit shall be disconnected.

2. Control relay functions shall be bypassed.

3. The Control Panel shall show a trouble condition.

4. The alarm activation of any initiation device shall cause the audible signals to code a number of pulses to match the zone number.

5. The panel shall automatically reset itself after code is complete.

6. Any momentary opening of alarm initiating or alarm indicating circuit wiring shall cause the audible signals to sound continuously for four (4) seconds to indicate the trouble condition.

H. The system shall be capable of logging and storing 300 events in an alarm log and 300 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence. The system shall have the capability of recalling alarms, trouble conditions, acknowledgements, silencing and reset activities in chronological order for the purpose of recreating an event history.

I. The TrueAlarm smoke sensor shall be a smoke density measuring device having no self contained alarm set-point. The alarm decision for each sensor shall be determined by the control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to the stored values. The control panel shall maintain a moving average of the sensors smoke chamber value. Systems that do not automatically maintain a constant smoke obscuration sensitivity for each detector by compensating for environmental factors are deemed not acceptable.

J. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each sensor:

1. Primary status.
2. Device type.
3. Present average value.
4. Present sensitivity selected *
5. Peak detection values *
6. Sensor range (normal, dirty, etc.

* Values shall be in "percent of smoke obscuration" format so that no interpretation is required by the operator.

K. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:

1. Clear peak detection values.
2. Enable or disable the point.
3. Clear verification tally.
4. Control a sensor's relay driver output.

L. It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week. (For example, to be more sensitive during unoccupied times and less sensitive during occupied periods.) There shall be seven (7) sensitivity settings available for each sensor.

M. The control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a 3% sensor reaches a threshold of 1.5% smoke obscuration.

N. The control panel shall be UL listed to support both fire alarm and mass notification functions. Speakers for the mass notification system are not included in this project.

1.5 SUPERVISION

A. When a trouble of any nature is detected, an audible trouble signal shall sound at the Fire Alarm Control Panel until the trouble is corrected or until it is manually silenced. In addition a "System Trouble" LED shall be illuminated and shall remain "On" until the trouble condition is corrected. A subsequent trouble condition received after manually silencing shall cause the audible trouble signal to "resound". Each independently supervised circuit shall include a discreet LCD readout to indicate disarrangement condition in that circuit.

B. Should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at preprogrammed time intervals to act as reminder that the Fire Alarm System is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable to suit the Owner's application.

C. The system shall contain independently supervised initiating circuits so that a fault in any one (1) zone shall not affect any other zone. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.

D. The alarm indicating device circuits shall be independently supervised and fused so that disarrangement of any circuit shall not affect the operation of the other circuits.

E. The system shall annunciate, at the Control Panel, the following trouble conditions for each addressable point within the system: open, short and device failed/missing. Should a device fail it will not hinder the operation of other system devices.

F. All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.

G. The power supply for the system shall be supervised so that loss of the incoming power, a low battery voltage condition or a battery disconnection will cause a trouble condition in the system. A green "power on" LED shall be displayed continuously while incoming power is present.

H. Wiring to the remote annunciator(s) shall be supervised for open and ground conditions.

I. The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value, a "Dirty Sensor" trouble condition shall be audibly and visually indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. If a "Dirty Sensor" is left unattended and its average value increases to a second predetermined value, an "Excessively Dirty Sensor" trouble condition shall be indicated at the control panel for the individual sensor. It shall be possible, at the control panel, to determine if any sensors are "Almost Dirty" to aid in maintenance of the system.

J. The control panel shall automatically perform a daily self-test on each sensor. Checking the electronics in the sensor's base ensures the accuracy of the values being transmitted to the control panel. A sensor which fails the self-test will cause a "Self Test Abnormal" trouble condition at the control panel. A sensor self-test which must be manually initiated by the operator shall not be acceptable.

1.6 POWER REQUIREMENTS

A. The Control panel shall receive 120 VAC power (as noted on the plans) via a dedicated circuit. An approved earth ground connection to the Control Panel shall also be provided.

B. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of 24 hours with five (5) minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.

C. All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the Control Panel

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The equipment furnished under this specification shall be as provided by Simplex to insure compatibility with existing equipment.

2.2 ACCEPTABLE MANUFACTURERS

A. The equipment furnished under this specification shall be the standard product of the Simplex Time Recorder Company whose catalog and model numbers are used to indicate the type and quality of design and materials as well as operating features required. The manufacturer's specification sheets of each item so listed shall be considered to be a part of these specifications and binding herein. Each component of the system shall display this manufacturer's name as well as a UL Label.

B. Similar equipment as manufactured by Notifier, Edwards Systems Technology or Siemens (Pyrotronics) subject to compliance with these specifications may be considered as equal.

2.3 FIRE ALARM CONTROL PANEL

A. Where shown on the plans, provide and install a Simplex Type 4100U Fire Alarm Control Panel. Construction shall be modular with solid-state, microprocessor based electronics. An 80 character LCD display shall indicate alarms, supervisory service conditions and any troubles. Keyboards or keypads shall not be required to operate the system during fire alarm conditions. The Fire Alarm Control Panel shall be in an enclosed metal surface-mounted cabinet specifically designed for public areas. It shall have a locked, hinged front door with two (2) master keys that also fit all other fire alarm apparatus utilizing keys for access.

B. The Control Panel shall be provided with alarm initiating circuits as required. Trouble and alarm conditions shall be indicated on the LCD display.

C. All fire alarm components and wiring systems shall be Class B.

D. The Control Panel shall provide communication with individually addressable initiating and control devices as indicated on the drawings. All of these devices will be individually annunciated at the Control Panel. There shall be no limit to the number of detectors, stations or Zone Adapter Modules, which may be activated or "in alarm" simultaneously.

E. Alarm signaling circuits shall be provided as required. Each circuit shall be separately fused and indicated on the LCD display. The number of circuits required shall be determined by a method which ensures that the end device received no less than 21 VDC operating power and in no case shall the circuit be initially loaded in excess of 80% of its rated capacity.

F. The Fire Alarm Control Panel shall have prerecorded voice annunciation capabilities including digitally recorded voice messages and speaker annunciation.

G. Control panel shall have digital alarm communicating transmitter for central station monitoring of alarms, troubles and supervisory conditions with specific point identification. Also provide contact closure digital communicating transmitter for off-site monitoring. Provide wiring to closest telephone termination board for off-site annunciation. The selection of a central monitoring agency, its fees and the fees for the leased lines are the responsibility of the Owner.

H. The Fire Alarm Control Panel shall allow for loading or editing special instructions and operating sequences as required. The system shall be capable of on site programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes. All software operations shall be stored in a non-volatile programmable memory within the Fire Alarm Control Panel. Loss of primary and secondary power shall not erase the instructions stored in memory. Systems that require factory reprogramming to add or delete addressable devices are unacceptable.

I. The Fire Alarm Control Panel shall include a multi-level password protection capability which can be applied to various system functions such as; alarm silence, alarm reset, manual control, disable/enable and walk test. Access to a level will only allow the operator to perform all actions within that level plus all actions of lower levels, not higher levels. The access level shall be in effect until the operator manually logs out or the keypad has been inactive for 10 minutes at which time the access level returns to its lowest level.

J. The "Control" module for the Fire Alarm System shall include annunciator supervision circuitry, earth ground detection, low or no battery voltage trouble monitoring and reporting and adjustable alarm silence inhibit capability as well as the reset, alarm silence, trouble silence switches and audible and visual trouble indicators. The Control Panel shall electrically supervise facilities for

automatic Fire Department notification. Relays shall be provided to accomplish the various control functions as specified in the system operation section and shall be capable of being bypassed for testing purpose.

K. The communication format to the addressable devices must be a completely digital poll-response protocol to allow t-tapping of the circuit wiring. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The system must verify that proper type device is in place and matches the desired software configuration.

L. Standby power for the system shall be provided by low maintenance sealed lead acid batteries specifically designed for Fire Alarm use and shall be kept fully charged by an automatic battery charger. Automotive type construction wet cell storage batteries or other non-fire alarm type batteries will NOT be acceptable.

2.4 FIRE ALARM CONTROL PANEL

A. The existing fire alarm control panel shall be provided with all necessary revisions to accommodate the additional fire alarm equipment as shown on the drawings and as specified herein including but not limited to the following:

1. Additional module(s) and equipment as required to connect new devices to the existing zone serving area.

2. Additional dual input zone modules and equipment as required to connect new devices to the following new zones.

a. Classroom First Floor.
b. Classroom Second Floor.

B. Provide new batteries sized to operate the system including new and existing component in a supervisory mode for 72 hours with a five (15) minute alarm operation at the end of this period.

2.5 MANUAL STATIONS

A. Manual stations shall be single action and shall be constructed of high impact, red lexan with raised white lettering and a smooth high gloss finish. Stations which utilize screwdrivers, Allen wrenches, or other commonly available tools shall not be accepted. Provide manual stations to match existing.

2.6 DETECTORS

A. Provide Photoelectric Smoke Detectors where indicated on the plans. Detectors shall be listed to UL Standard 268 and shall be documented compatible with the control equipment to which it is connected. The detectors shall obtain their operating power from the Fire Alarm panel supervised detection loop. Removal of the detector head shall interrupt the supervisory circuit of the Fire Alarm detection loop and cause a trouble signal to be generated at the Control Panel. Each detector shall have a flashing status indicating LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady and at full brilliance. The detector may be reset by actuating the Control Panel reset switch.

B. Duct smoke detectors shall include a solid-state photoelectric type detector operating on the light scattering photodiode principle. The detectors shall be designed to ignore invisible airborne particles or smoke densities that are below the factory set alarm point. No radioactive materials

shall be used. Detector construction shall be of the split type that is, mounting base with twist-lock detecting head. Contacts between the base and head shall be of the bifurcated type using spring-type, self-wiping contacts. Removal of the detector head shall interrupt the supervisory circuit of the Fire Alarm detection loop and cause a trouble signal at the Control Panel. Detector shall have an alarm LED visible through the front cover. Detectors shall obtain their operating power from the supervised current in the Fire Alarm loop. Installation must comply with NFPA-90A.

C. All air handling units over 2,000 CFM shall deactivate and all smoke and fire/smoke dampers shall close.

D. Remote alarm LED indicators shall be provided for each Duct Smoke Detector. Indicators shall be mounted in an easily accessible location and shall identify the unit it serves and also indicate supply or return.

E. Automatic heat detectors shall be combination rate-of-rise and fixed-temperature type. When the fixed-temperature portion is activated, the units shall be non-restorable and give visual evidence of such operation. Heat detectors shall be 135°F or 194°F. In high hazard areas with high temperature, furnish 200°F fixed temperature detector. They shall be of the replaceable element type and shall visually indicate an alarm condition when operated.

2.7 ALARM SIGNALING DEVICES

A. Alarm horns shall be polarized and shall be operated by 24 VDC. Each horn assembly shall include separate terminals for in/out wiring for each leg of the associated signal circuit. T-tapping of signal device conductors to signal circuit conductors shall NOT be accepted.

1. Alarm annunciation dB levels shall meet the Americans with Disabilities Act (ADA), UL, NFPA and local codes.

B. Alarm speakers shall produce a temporal pattern.

1. Alarm annunciation dB levels shall meet the Americans with Disabilities Act (ADA), UL, NFPA and local codes.

C. Visible alarm indicating devices shall be entirely solid state and comprised of Xenon flashtube. Visual alarm units shall meet the photometric requirements of the Americans with Disabilities (ADA), UL, NFPA and local codes. The unit shall be complete with a tamper-resistant Lexan lens and the word "FIRE" in red letters.

1. The drawings indicate areas requiring visual devices. The intensity level of each device, exact quantity and location per area shall be determined by manufacturer and devices provided accordingly.

2.8 MISCELLANEOUS DEVICES

A. Fan shutdown relays shall be provided as required and shall be compatible with the unit being controlled.

B. Provide connection to smoke and combination fire/smoke dampers.

C. Door holders shall be provided as work of this Section. Connections to door holders shall be provided as work of this Section.

2.9 WIRE

A. All wire and wiring shall be in strict compliance with all of the provisions of the National Electrical Code, Article 760, the manufacturer's recommendations and requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The entire system shall be installed in a workmanlike manner in accordance with approved manufacturer's wiring diagrams. The Contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for a complete installation. All wiring shall be of the type recommended by the manufacturer and approved by the local authority having jurisdiction and shall be installed in conduit or surface metal raceway throughout. All junction boxes shall be sprayed red and labeled "FIRE ALARM". Wiring color code shall be maintained throughout the installation.

B. Installation of equipment and devices that pertain to other work in the Contract shall be closely coordinated with the appropriate Subcontractors.

C. Cover all smoke detection devices with plastic bags immediately after installation to maintain cleanliness, if field conditions so require.

D. The Contractor shall clean all dirt and debris from the inside and the outside of the Fire Alarm equipment after completion of the installation.

3.2 FINAL CONNECTIONS, TESTING, INSPECTION AND ACCEPTANCE

A. The Contractor shall, under this Contract, obtain the services of a factory trained representative of the system manufacturer to supervise the installation and it's progress, supervise final connections to the equipment and provide testing to assure that the system is in proper operating condition and is in compliance with all applicable regulations. A complete functional test of the system in accordance with NFPA 72H shall be performed and a written report shall be submitted to the Contractor attesting to the proper operation of the completed system. The Contractor shall have present representatives of the manufacturer of the Fire Alarm System, authorities having jurisdiction and the Architect during final inspection. The Contractor shall demonstrate to the satisfaction of all parties that the system installed meets the specification requirements. All changes, modifications and adjustments to the installed system needed to meet the specification requirements will be made at no additional cost to the Owner.

B. Upon completion of the installation, printed system operating instructions and as-built wiring and layout drawings will be furnished to the Owner.

3.3 GUARANTEE AND AFTER SERVICE

A. The Contractor shall warrant the completed Fire Alarm System wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.

B. Upon satisfactory completion of all tests, the manufacturer's representative will present to the Owner a proposal to provide inspections and testing of the system in compliance with the requirements of the state and local fire codes.

C. The system's vendor must employ factory trained technicians and maintain a service organization within 50 miles of the Job Site. This organization must have a minimum of 10 years experience servicing Fire Alarm Systems and provide 24 hour emergency service.

D. The vendor shall provide a maximum of four (4) hour response to the Owner's request for service. The vendor will demonstrate this capability to the Owner and will provide this minimum response under all reasonable circumstances.

END OF SECTION

DIVISION 31 - EARTHWORK

SECTION 31 10 00
EARTHWORK

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Soils Testing	Section 01 40 00
Building Earthwork	Section 31 10 10
Pavement and Walks	Section 32 16 13

QUALITY ASSURANCE

A qualified independent geotechnical engineering testing agency shall provide inspection service during construction. Inspection services shall include approval of materials to be used as fill, examination and approval of slab subgrades, and testing of fill and backfill compaction. See Section 01 40 00 for additional information.

UTILITY REMOVAL

Before the Contractor begins his grading operations, he shall confer with the Mechanical and Electrical Subcontractors to assure that they have contacted the owners of any underground or overhead utilities which may be on or in close proximity to the grading areas, and have arranged for the necessary locating, disconnection and capping of these utilities in accordance with the regulations of the utility company concerned. Such utility locating, disconnections and capping, if performed by the owning utility company, shall be paid for by the respective Mechanical or Electrical Subcontractors. Where such locating, disconnection and capping is not customarily performed by the owning utility, the locating, respective Mechanical or Electrical Subcontractors shall perform the disconnection and capping, and the costs shall be included in their Bids. See Section 02 20 00 for further information about locating, disconnection and capping of utilities. The Contractor shall take such measures as required in properly protecting any utilities which are scheduled to remain throughout the period his grading operations are in progress. Whenever and wherever locating, disconnection and removal operations are undertaken by the Mechanical or Electrical Subcontractors, or the owners of the utilities, the Contractor shall cooperate to the extent that ample protection of their work will be provided, so that the entire work as contemplated is expedited to the best interests of all concerned.

Known existing abandoned utility lines shall not be allowed to remain under any areas less than 6 feet outside the building line regardless of the depth of the line within the grading limits of this project. They shall not be allowed to remain under paving and walk areas or non-paved areas where the utility will be less than 3 feet below finish grade. Where abandoned utilities are required to be removed, they shall be totally removed and the excavations backfilled and compacted as specified elsewhere in this Section. Where abandoned utilities will remain in place, the abandoned sections shall be capped.

PROTECTION OF EXISTING SERVICE LINES AND UTILITY STRUCTURES

The existing service lines and utility structures which are scheduled to remain and which are shown or indicated on the Drawings, the location of which is known to the Contractor prior to excavation or construction of fills shall be protected and safe-guarded from damage during grading operations, and, if damaged, shall be repaired by the Contractor at his expense. The above provisions are applicable to all service lines or utility structures, all or any portion of which protrudes above the original ground surface or lies beneath the ground surface within any grading area. Any existing line or utility structure which is not shown on the Drawings, or the location of which is not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged, shall be repaired by the Contractor, and an adjustment in payment will be made by the Government at rates determined and approved by the Contracting Officer. If extra expense is incurred by the Contractor in protecting and safeguarding any service line or utility structure which is not shown on the Drawings, and is not known at the time of bidding, adjustment in payment will be made by the Government at the rates determined and approved by the Contracting Officer.

PROTECTION OF EXISTING BUILDINGS AND STRUCTURES

Contractor shall guard against, and be responsible for, any movement, settlement or collapse of existing buildings, structures, sidewalks, street passages, and underground utilities. Contractor shall repair damage done to the Government's property or any other property, on or off premises, by reason of required work. Contractor shall adequately brace all walls during backfilling and compacting operations.

Provide for surface drainage during period of construction in a manner that will protect newly graded and adjacent areas. At all times, maintain positive drainage away from building area.

Protect all excavations within construction areas from the action of the elements. Keep excavations free of water at all times during the entire progress of construction, regardless of the cause, source, or nature of the water. Temporarily grade away from excavated areas to prevent excessive moisture from penetrating those areas.

EROSION CONTROL

All codes and ordinances regarding erosion control requirements shall be complied with.

Every precaution and temporary measure shall be taken, such as silt fences, to prevent damage from erosion of freshly graded areas. This shall apply to damage of newly graded areas within construction limits and damage to adjacent properties by eroded materials.

ADJOINING STREETS AND ROADS

The Contractor shall clean adjoining streets, removing excessive dirt and soil caused by construction traffic to and from the construction site.

CARE OF TREES SCHEDULED TO REMAIN

The Contractor shall exercise all possible care to minimize damage to roots or other members of trees scheduled to remain.

TEMPORARY BARRICADES/FENCING

Contractor shall install barricades and/or temporary fencing during excavation and earthwork as required for public safety.

B. PRODUCTS

FILL MATERIAL

Fill material shall be all suitable material removed from excavation areas. Any off-site borrow material shall be clean, inorganic silt or lean clay with a liquid limit less than 45 and a plasticity index between 10 and 20. All fill to be used shall be approved by the Geotechnical Consultant. All fill material shall be reasonably free from roots or other organic materials, trash, frozen material, and all stones having a maximum dimension greater than 3 inches. Sand **shall not** be used as backfill at walls, utility trenches or similar locations.

C. EXECUTION

PREPARATION

At areas where fill is to be placed, remove vegetated material and haul off-site. Stockpile topsoil for later installation at graded areas scheduled to be sodded.

Coordinate with the Mechanical and Electrical Subcontractors to assure that they have notified the Utility Companies which have utilities that interfere with construction and have arranged for their disconnection.

GENERAL EXCAVATION AND FILLING REQUIREMENTS

Excavate to lines and grades indicated on the Drawings. Suitable excavated material from on-site locations shall be placed as fill. During construction, excavation shall be performed in a manner and sequence that will provide drainage at all times. All areas under and within 10 feet of building areas and under and within 5-feet of paving and walk areas which are scheduled to receive fill shall also be inspected before the fill is placed.

Fills shall be constructed at locations and to lines and grades indicated on the Drawings. Completed surfaces shall correspond to the shape of the typical sections shown on the Drawings, or shall meet the requirements of the particular case.

If conditions are encountered at the bottom of any excavations, which are judged to be unacceptable by the Government Construction Representative, who may direct that the excavations be carried to lower elevations than shown on the Drawings. Under that circumstance, the unacceptable existing materials shall be removed as an extra cost to the Contract.

PREPARATION OF GROUND SURFACE FOR FILL

All vegetation, such as roots, brush, heavy growth of grass, and all decayed vegetable matter, rubbish, and other unsuitable material within areas upon which fill is to be placed, shall be stripped or otherwise removed before fill is started. In no case shall such objectionable material be allowed to remain in or under fill areas. After stripping to at least a 9-inch depth, the exposed subgrade shall be proof rolled in the presence of the Geotechnical Engineer. A minimum gross weight of 25 tons shall be used for the proofrolling equipment. Remove unsuitable materials so detected as directed. Scarify approved subgrades to at least a 9-inch depth and moisture-condition to within -3 to +3 percent of optimum moisture content. Compact approved subgrades as specified for fill. Protect approved subgrades from damage or rework damaged subgrades as directed. Ground surface that slopes steeper than five to one upon which fill is to be placed shall be stepped before receiving fill materials.

PLACEMENT

Fill shall be placed in successive horizontal layers not to exceed 9 inches in loose depth. Fill shall be compacted by rolling with an approved tamping roller or other means as approved by the Geotechnical Consultant.

SPREADING OF TOPSOIL

Upon completion of rough grading, the Contractor shall spread the stockpiled topsoil for a uniform depth of 6 inches over all areas graded under this Contract not receiving other surfacing. Before spreading topsoil, graded areas shall be scarified for a depth of 3 inches, and all settlements and washes shall be repaired. Finish grade shall be held 1 inch below adjacent curbs, pavement and walks.

FINISHED EXCAVATION

Uniformly smooth grading of all areas covered by the project, including excavations and adjacent transition areas shall be accomplished. Finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade grader operations, except as otherwise specified. Finished surface shall be not more than 0.15 feet above or below established grade or approved cross section. All swales shall be finished so as to drain readily. Construction debris shall not be present to any significant extent in the final finish grade. This latter requirement will be strictly enforced.

Soils in the building areas, and within 10 feet of the building perimeter, shall be protected against moisture content increase throughout the construction period. Footing and utility excavations shall be exposed for as short a time as practical, and, if water enters the excavations, the softened soils shall be removed completely before footings or utilities are placed. All swales shall be kept a minimum of 20 feet away from exterior walls.

SPECIFIC EXCAVATION AND FILL REQUIREMENTS

At all paving and walk areas, scarify and recompact the top 9-inches or install a minimum of 9-inches of new fill.

Granular fill may not be used to backfill exterior utility lines or interior underfloor plumbing lines, except a maximum of 4-inches of granular bedding material may be used under the lines. Interior mechanical or electrical items

located not more than 12 inches below bottom of slab-on-grade may be backfilled using granular material.

At Contractor's option, use of fly ash as a drying agent to facilitate fill placement is acceptable if the fly ash is well blended with silty clay soil to form a uniform cohesive mixture. The cost of fly ash, if used, will not be considered as an additional cost to the contract.

COMPACTION OF FILL

All fill and backfill shall be wetted or dried by aeration, and then compacted to the following percentage of maximum density, at a moisture content within the limits specified above or below optimum moisture content, as determined by Testing Procedure ASTM D-698-70 (Standard Proctor), unless otherwise noted. These compaction requirements shall also apply to all utility trenches in the respective areas.

Material	Percent of Maximum Density	Percent Above or Below Optimum Moisture Content
• Non-supporting fill	95% minimum	-3 to +3 %
• Non-supporting backfill	95% minimum	-3 to +3 %
• Supporting fill & backfill (beneath & within 10' of the building & beneath & within 5' of walks & concrete pavements)	98% minimum	-3 to +3 %
• Supporting fill below structural foundations	98% minimum	-3 to +3 %
• Supporting fill & backfill (beneath & within 5' of asphalt paving)	98% minimum	-3 to +3 %

QUALITY CONTROL

See Testing Laboratory Services (Section 01 40 00).

Testing Laboratory shall take the number of tests required to determine the specified compaction. Fill and backfill not meeting the required compaction, as determined by the Testing Laboratory, shall be removed, replaced, recompacted, and retested at the expense of the Contractor.

Testing Laboratory shall inspect the bottom of all footing excavations before installation of footing begins. Since most footings for this project will be founded in cut areas, any pockets of loose or unstable soil that are found in the original soils by the Testing Laboratory shall be dug out and recompacted as an extra cost to the Contract.

INSPECTION

See references earlier in this Section regarding specific inspections that the Testing Laboratory shall make. Notify the Testing Laboratory if any conditions are uncovered which appear to be questionable as far as soil-bearing capacity is concerned.

CLEAN-UP

Upon completion of the project and prior to Final Acceptance, all finished graded areas shall be made free of all debris and materials, including construction-related broken concrete, masonry, wood, stone, rock, metal, insulation, roofing, plastic and paper materials. Debris and materials shall not be covered with soil or otherwise buried on the site but shall be completely removed from the site.

SECTION 31 10 10
BUILDING EARTHWORK

A. GENERAL

DESCRIPTION

Work specified in this section covers earthwork required in placing the foundation and slabs.

RELATED WORK SPECIFIED ELSEWHERE

Soils Testing	Section 01 40 00
Cast-in-Place Concrete	Section 03 30 00
Earthwork	Section 31 10 00 (Including excavation and compaction requirements)

QUALITY ASSURANCE

A qualified independent geotechnical engineering testing agency shall provide inspection service during construction. Inspection services shall include approval of materials to be used as fill, examination and approval of slab subgrades and footing excavations, and testing of fill and backfill compaction. See Section 01 40 00 for additional information.

C. EXECUTION

GENERAL

General excavation work shall be done in accordance with the requirements of the Drawings and Specifications and in a manner which will ensure reasonable accuracy in preserving lines and levels shown on the Drawings. Excavation for buildings shall be carried far enough beyond wall line to permit removal of forms, and to permit installation of damproofing and drainage structure, where occurring.

FOUNDATION EXCAVATION

Surface water shall not be allowed to stand in the foundation, but shall be removed immediately. Any soil that inadvertently becomes wet must be removed before footings are placed.

Contractor shall avoid moulding the subgrade by vehicle traffic. Any such moulded areas shall be removed and recompacted to meet the requirements of this Section and Section 31 10 00.

Pour foundation immediately after excavation is completed and subgrade is approved by the geotechnical testing agency. Concrete for footings, which bear on earth, shall be placed on undisturbed soil and/or compacted fill. When footings are inadvertently over excavated below elevations shown on the Drawings, the footings shall be filled to the proper level with concrete.

Where suitable bearings are encountered at different elevations from those indicated on the Drawings, the excavation shall be carried to elevations above or below those indicated on the Drawings as directed by the Government Construction Representative. Adjustment in payment shall be made in accordance with the terms outlined in Section 31 10 00.

Where excavation is made below the elevations indicated on the Drawings, the excavation shall be restored to the proper elevation in accordance with the procedure specified for filling and compaction of fill in Section 31 10 00.

BACKFILLING

Place backfill for structures in horizontal uniform layers not to exceed 6 inches. Bring each layer up uniformly on all sides of the structure and thoroughly compact using a sheepsfoot type roller or other methods as approved by the Geotechnical Engineer. See Section 31 10 00 for compaction and testing requirements.

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 16 13
PAVEMENT AND WALKS

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Testing Laboratory Services	Section 01 40 00
Sealants	Section 07 92 00
Earthwork	Section 31 10 00

TESTING SERVICE

A qualified Testing Laboratory service shall perform installation evaluation tests/inspections on the work of this Section. See testing requirements described at the end of this Section, and see Section 01 40 00 for additional information.

SUBMITTALS

Submit the following concrete mix design information in accordance with Section 01000:

- Pounds of water per pound of cement
- Slump in inches
- Percent air content
- Type and quantity of admixtures used
- Compressive strength
- Source of each aggregate
- Aggregate gradation
- Pounds of aggregate per cubic yard
- Mix design in conformance with ACI 318

ASPHALTIC CONCRETE PAVING

The design mix for asphalt set forth in these Specifications is to establish a quality of pavement. If the aggregate mixture specified herein is unavailable, the Contractor shall submit a design mix, which is equal or better than the design mix specified, as determined by the Contracting Officer. The submittal shall list the aggregate mix, percent of asphalt cement, percent of compacted density, and percent of voids for both base and surface courses.

ASPHALTIC CONCRETE WEATHER LIMITATIONS

Apply tack coats when ambient temperature is above 50 deg. F and when temperature has not been below 35 deg. F for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture. Construct asphalt concrete surface course when atmospheric temperature is above 40 deg. F and rising and when base is dry. Base course may be placed when air temperature is above 30 deg. F and rising.

B. PRODUCTS

PORTLAND CEMENT CONCRETE MATERIALS

Forms shall be constructed of steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.

Concrete materials and mixes shall be as follows:

Provide 4,000 PSI, 28-day compressive strength concrete with 611 pounds cement per cubic yard minimum, a W/C

ratio of 0.42 maximum, and air entrainment of 6% +/- 1% for all concrete on this project. All materials shall comply with ACI 301, except as modified by this Specification.

Slump limits at point of placement shall be not less than 1 inch and not more than 4 inches.

Portland Cement shall conform to ASTM C 150, Type I.

Normal weight aggregates shall conform to ASTM C 33 and shall be from sources approved by the Nebraska Department of Roads for Class 47-B concrete. Coarse aggregate shall be limestone and fine aggregate shall be sand-gravel. Aggregate for concrete shall be proportioned as follows:

Coarse Aggregate (Limestone): 30% of total aggregate by weight
Fine Aggregate (Sand-Gravel): 70% of total aggregate by weight

Aggregates for concrete must be consistent and equal quality, gradation, and color throughout the project.

Water shall be potable.

Air-entraining admixtures shall conform to ASTM C 260 unless otherwise indicated. Add air-entraining admixture to all concrete at manufacturer's prescribed rate to result in concrete at point of placement having air content of 5 to 7 percent for maximum 3/4-inch aggregate, 6 to 8 percent for maximum 1/2-inch aggregate.

Other admixtures, if used, shall conform to ASTM C 494 and shall be used in strict compliance with manufacturer's directions.

Use water-reducing admixture in all concrete.

Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators.

Expansion joint filler for concrete walks, paving and curbs (only if hot-applied rubber asphalt sealant is used) shall be fiber type, composed of cane fibers uniformly saturated with a bituminous binder, which meet the requirements of ASTM D 1751. Thickness shall be as shown on the Drawings.

Curing compound for concrete walks (to be used if mat cure is not used) shall be as specified hereinafter under "Curing of Portland Cement Concrete ". Curing compounds shall conform to TT-C-800, with 30% solids content minimum, except when used in cold weather concreting.

ASPHALTIC CONCRETE MATERIALS

Aggregate for base and surface courses shall consist of (any one or blend) crushed stone, crushed gravel, screenings, sand, and mineral filler. Crushed stone shall consist of clean, sound, durable fragments, free from an excess of flat, elongated, soft or disintegrated pieces, dust, dirt, or other objectionable matter.

Asphaltic concrete for base and surface courses shall meet the requirements of Section 400 of the City of Omaha Standard Specifications for Public Works Construction, latest edition. Surface course shall be CMU mix type.

Emulsified asphalt; AASHTO M 140 (ASTM D 997) or M 208 (D 2397), SS-1, SS-1h, CSS-1, or CSS-1h, diluted with one part water to one part emulsified asphalt.

Asphalt cement for surface course shall be Type PG70-28. Asphalt cement for base course shall be Type PG64-22.

Thickness of base course and surface course shall match existing asphalt pavement.

C. EXECUTION

JOB CONDITIONS

During hot or cold weather, concrete paving, walks, and other improvements shall be installed as specified below. Make no alterations in materials without approval. Water shall not be added at the jobsite to change the mix design.

Concrete shall be rejected where water has been added. No exceptions will be made.

Cold weather requirements shall conform to ACI 306, Recommended Practice for Cold Weather Concreting. Hot weather requirements shall conform to ACI 305, Recommended Practice for Hot Weather Concreting.

SUBGRADE PREPARATION

Subgrades for all drives, parking areas, sidewalks, and other structures shall be shaped, dressed, moistened, and compacted as required by Section 31 10 00. The subgrade shall be tested for crown, elevation, and density in advance of placing pavement and sidewalks. Soft or unsuitable material shall be removed and replaced with approved material. Low sections, holes, or depressions shall be brought to required grades with approved material and the entire subgrade shaped to line, grade and cross section, and thoroughly compacted as specified. See Section 31 10 00 for compaction requirements.

Remove loose material from compacted subbase surface immediately before placing any concrete or asphalt material. Do not begin paving or walk work until deficient subbase areas have been corrected and are ready to receive materials.

PORTLAND CEMENT CONCRETE

Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

Comply with requirements of ASTM C 94, and as herein specified. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to the batch will not be permitted.

Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required, to provide a uniform dampened condition at time concrete is placed.

Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing and joint devices.

PORTLAND CEMENT CONCRETE JOINTS

Construct control joints true-to-line with the face perpendicular to the concrete. Where adjoining existing paving or sidewalks, place transverse joints to align with previously placed joints, unless otherwise indicated.

Provide control joints, sectioning concrete into areas as shown on the Drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness as follows:

Tooled joints: Form weakened-plane joints in fresh concrete by grooving the top portion with a recommended cutting tool and finishing edges with a jointer. Tooled joints shall be rounded with trowel edge marks broomed out and shall occur at all control joints required at curbs, walks, and other similar concrete site improvements.

Sawed joints: Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded or otherwise damaged by cutting action. Sawed joints shall occur at all control joints required at drives and paving areas only.

Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 2 hours. Construction joints shall be located only at expansion joints in sidewalks and only at expansion joints or contraction joints in paving. Construct joints as shown or, if not shown, use standard metal keyway-section forms.

Provide joint fillers, hereinbefore specified, for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated. Extend joint fillers full-width and depth

of joint, and not less than 2" or more than 1" below finished surface for joint sealer. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.

Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

Comply with the requirements of Section 07 92 00 for preparation of joints, materials, installation, and performance.

PORTLAND CEMENT CONCRETE FINISHES

After striking-off and consolidating concrete, smooth surface by screeding and floating. Hand methods shall be used only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

Concrete for curbs and gutters shall be consolidated so as to produce a dense concrete in which mortar has been worked into the surface. Concrete shall then be struck off to the required cross section, and the upper face of the gutter slab, front face, and top of curb shall be smoothed with a wood float.

After floating, test surface for trueness with a 10' straightedge placed at 5' intervals and overlapping 5' on each check. No deviation of more than 1/8" shall be allowable. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2" radius, unless otherwise indicated. Broom out trowel edge marks on concrete surface.

After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing with a broom finish, by drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture.

Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by the Government Construction Representative.

CURING OF PORTLAND CEMENT CONCRETE

Cover and protect curing concrete from moisture evaporation, rapid temperature change, rain, flowing water, and mechanical injury, during a period of at least 72 hours immediately following the finishing. The use of a covering material, which contains or becomes contaminated with sugar in any form, tannic acid, or any other substance considered detrimental to Portland Cement, will not be permitted.

MAT CURING

Mats of burlap, cotton, or other fibrous material having similar water absorptive properties shall be thoroughly wet when applied, and kept continuously wet and in intimate contact with the covered surface for the duration of the curing period. Mats shall be uniform in thickness, weigh not less than 20 oz. per square yard when dry, and be capable of absorbing at least 12 times their weight of water. If burlap is used, it shall be used in multiple, not single layers.

MEMBRANE FORMING CURING COMPOUNDS
(to be used if mat cure is not used)

Curing compounds shall be agitated thoroughly during use, and shall be sprayed uniformly, in a single coat, by approved spraying equipment on all concrete surfaces, at a rate recommended by the manufacturer and based on moisture retention tests. Application shall be made immediately following the final finishing operation.

The initial curing medium shall be effective, and applied so as to prevent checking, cracking, and the appearance of dry spots on the surface of the concrete. The sides of concrete slabs exposed by the removal of forms shall be protected immediately to provide continuance of curing, and prevent injury of slab edges and the underlying

subgrade.

ASPHALTIC CONCRETE PAVING - GENERAL

Apply tack coat to contact surfaces of previously constructed asphalt or portland cement and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gal. per sq. yd. of surface. Allow to dry until at proper condition to receive paving.

Place asphalt concrete mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225 deg. F. Place inaccessible and small areas by hand. Place each course to required grade, cross-section and compacted thickness.

Place in strips not less than 6' wide. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips minimum 6". Complete base course for a section before placing surface course.

Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

ROLLING COMPACT ASPHALTIC CONCRETE – GENERAL - PARKING AND DRIVE AREAS

Begin rolling when mixture will bear roller weight without excessive displacement. During rolling, the wheels of the rollers shall be moistened to prevent adhesion of the mixture to the wheels but an excess of water will not be permitted. Compact mixture with hot hand tampers or vibrating plate compactors in areas in- accessible to rollers. Hand tampers shall weigh not less than 25lb and shall have a tamping face of not less than 50 square inches.

Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material. Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted. Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

Remove and replace paving areas mixed with foreign materials and defective areas. Cutout such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.

After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

WEATHER PROTECTION

When it is expected during the progress of work and before all concrete has attained final set that the temperature may fall below 35 deg. F, a sufficient supply of straw, hay or other material must be maintained on hand on the project site to cover the concrete and to adequately protect its surface and edges against freezing until it is at least 10 days old.

Protect concrete from damage until acceptance of work. Exclude traffic from pavement and sidewalks for at least 14 days after placement. When construction traffic is permitted, maintain pavement and sidewalks as clean as possible by removing surface stains and spillage of materials as they occur.

Sweep concrete pavement and sidewalks and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.

REPAIR OF EXISTING PAVEMENT SURFACES

Existing concrete and asphaltic concrete parking and drive surfaces indicated on the Drawings to remain shall be repaired as follows, if damaged or broken as result of the execution of this Contract:

1. All surfaces damaged or broken shall be removed and replaced with new matching material.
2. Cracks and openings shall be filled, sealed, and closed flush with adjacent surfaces with hot applied rubber asphalt pavement sealer as listed in Section 07900.

3. Repaired and cleaned asphalt pavement surfaces shall receive one (1) coat of asphalt pavement sealer applied in strict accordance with the manufacturer's printed recommendations.

FIELD QUALITY CONTROL OF ASPHALTIC CONCRETE PAVING

Crown profile, grade, and tolerance of finished surfaces shall be tested by the Contractor after initial compression. Variations shall be corrected by removing or adding material before rolling is continued.

Test in-place asphaltic concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by the Government Construction Representative. The Contractor shall place additional lifts as necessary to achieve specified thickness or smoothness.

CONCRETE QUALITY CONTROL TESTING DURING CONSTRUCTION

The Contractor shall require that a test set be made for each 25 cubic yards of concrete, but there shall be at least one test set for each day's concreting. Each test set shall include the following:

1. Three Compression Test Specimens to be made, tested, and evaluated in accordance with ACI 301.
2. Slump Test made in accordance with ASTM C 143.
3. Test for Entrained Air Content in accordance with ASTM C 231 or ASTM C 173.

Test hourly when air temperature is 40 deg. F or below, or when 80 deg. F and above; and each time a set of compression test specimens is made.

The Testing Service shall make additional test of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Government Construction Representative. Testing Service may conduct tests to determine adequacy of concrete complying with ASTM C 42, or by other methods as directed. See Section 01 40 00 regarding costs for such testing.

SECTION 32 92 00
LAWNS

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Earthwork	Section 31 10 00

SCOPE

The areas and limits of the site to be sodded are as noted on the Drawings.

REQUIREMENTS OF REGULATORY AGENCIES

Weed herbicides shall be used in accordance with the Specifications or the prevailing Public Health Authority.

GUARANTEE

Contractor shall guarantee work covered by this Specification to the extent that all lawn areas shall be firmly rooted, and that the entire lawn area shall be uniform in color and quality, and shall be reasonably free of weeds, diseases or other visible imperfections at acceptance.

PRODUCT DELIVERY, STORAGE AND HANDLING

Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product. Protect sod from sun, wind and moisture prior to installation.

Deliver products in original unopened packaging with legible manufacturer's identification.

Where required by law, inspection certificates shall accompany each shipment invoice or order.

Sod shall be rolled or folded prior to lifting. Handling of sod shall be done in a manner that will prevent tearing, breaking, drying or any other damage.

SCHEDULE

Spring planting season shall be from May 15 to June 30 inclusive. Fall planting season shall be from August 15 to September 30 inclusive.

Actual planting shall be performed only during periods of favorable weather conditions or when conditions are suitable for planting operations.

B. PRODUCTS

SOD

Sod shall be commercially produced on or harvested from mineral based soils. The soil upon which sod is produced or harvested from shall consist of less than 10 percent organic matter by mass. The sod shall be dense, fine leafed, and of uniform texture. The sod shall consist of a blend of 4 or 5 fine leafed turf grasses. At least 35 percent of the grasses, as determined by initial seeding proportions, shall consist of improved type Kentucky bluegrass varieties. It shall be vigorous, well-rooted, healthy sod, free from disease, insect pests, weeds, other grasses, stone, and any other harmful or deleterious matter. Sod shall be machine stripped at a uniform soil thickness of approximately one inch. The measurement for thickness shall exclude top growth and thatch, and shall be determined at the time of cutting in the field.

MISCELLANEOUS

Fertilizer for sod areas shall be 20-10-5 commercial fertilizer.

C. EXECUTION

PREPARATION

Fine grade and rake areas to a firm even surface, free from lumps, stones or clumps 1-inch or more in any dimension. Grade elevation prior to installation shall be 2-inches below the top of sidewalks, curbs, etc. Installation of lawn may be done immediately after finish grading, provided the bed has remained in a good condition and has not become muddy or hard. If it has become hard, it shall be tilled to a friable condition again.

FERTILIZATION OF AREAS TO BE SODDED

1. Fertilize areas to be sodded with fertilizer, applied at a uniform rate of 1 pound of Nitrogen per 1,000 S.F.
2. Harrow or rake fertilizer into the top 1 1/2" of topsoil.

HANDLING OF SOD

Sod shall be rolled or folded prior to lifting. Handling of sod shall be done a manner that will prevent tearing, breaking, drying or any other damage.

SODDING PROCEDURES

Lay sod perpendicular to the direction of the slope and in a manner which will permit joints to alternate. Fit sod pieces together tightly so that no joints are visible, and tamp sod firmly and evenly by hand. All sodded areas for slopes of 5 to 1 or steeper shall be staked with wooden stakes to prevent displacement. All sodded areas shall be watered immediately after final rolling with a fine spray. Sod shall be installed in place on the site not more than 48 hours after cutting.

MAINTENANCE OF GRASS AREAS

Water, weed and resod in a satisfactory manner for a period of three months or until the Substantial Completion Date, whichever comes last.

Install and maintain temporary protection fences, barriers and signs where deemed necessary.

Repair areas damaged due to circumstances which are beyond Contractor's control after submitting a request for a Change Order and obtaining approval for same from the Contracting Officer.

MOWING

At the time of the first cutting, mower blades shall be set to produce a 2 1/2-inch to 3 1/2-inch mowed height. Lawns shall receive at least two mowings before the Substantial Completion Date. After two cuttings, any further mowing required shall be by the Government.

SECTION 32 93 00
LANDSCAPING

A. GENERAL

RELATED WORK SPECIFIED ELSEWHERE

Earthwork	Section 31 10 00
Lawns	Section 32 92 00

QUALITY ASSURANCE

Plants shall be nursery grown, with scientific and common names of plants to conform with the approved names given in "Standard Plant Names" prepared by American Joint Committee on Horticultural Nomenclature and to meet the requirements of "Horticultural Standards" of Rules and Grading adopted by the American Association of Nurserymen.

Landscape subcontractor shall visit the site to observe any unfavorable conditions, and if found that the plant material is unsuitable for the specific area, he must so notify the Contracting Officer prior to ordering the plants.

Each separate plant and each bundle of plants shall be properly identified with a securely attached label.

DELIVERY, STORAGE AND HANDLING

Roots or balls of all plants shall be adequately protected at all times from sun and drying winds or frost.

1. All Balled and Burlapped Plants which cannot be planted immediately upon delivery shall be set on the ground, and shall be well protected with soil, wet moss, or other acceptable material. Bare-root plants, which cannot be planted immediately, shall be heeled-in in trenches immediately on delivery.
2. Bundles of Plants shall be opened and plants separated before the roots are covered. Care shall be taken to prevent voids among the roots. During planting operations, bare roots shall be covered with canvas, hay, or other suitable material. No plant shall be bound with wire or rope at any time so as to damage the bark or break the branches.

PLANTING SEASON

Spring planting season for bare-root plant materials shall be from May 15 to June 1, and for balled and burlapped plants from May 15 to June 30 inclusive.

Fall planting season for balled and burlapped plants shall be from September 1 to September 30 inclusive.

Actual planting shall be performed only during periods of favorable weather conditions or when conditions are suitable for planting operations. Coordinate planting and maintenance of all materials with Government Construction Representative prior to installation. Project completion dates will be amended if planting or required maintenance is in conflict with schedule.

JOB CONDITIONS

In the event that rock, underground construction work, utilities or other obstructions are encountered in any plant pit excavation work to be done under this Contract, alternate locations shall be selected by the Government Construction Representative.

GUARANTEE

Plants shall be guaranteed by the Contractor for a period of one year beginning on the Substantial Completion Date. Defective plants shall be replaced without additional cost to the Government.

At the end of the guarantee period, inspection of plants will be made by the Contracting Officer, upon written notice requesting such inspection submitted by the Contractor at least ten days before anticipated date of inspection.

Any plant required under this Contract that is dead, not true to name or size as specified, or not showing satisfactory growth, as determined by the Government Construction Representative in conjunction with the Contractor, shall be removed from the site.

All replacements shall be plants of the same type, size, and character as specified in the Plant List. They shall be furnished and planted as specified under Planting Operations. The cost shall be borne by the Contractor except for possible replacements resulting from loss or damage due to the occupancy of the project in any part, vandalism, civil disobedience, or acts of neglect on the part of others; physical damage by animals, vehicles, fire, etc., due to curtailment of water by local authority; or the "Acts of God". Plants missing due to the Contractor's negligence shall be replaced once in a manner defined under the guarantee period. The Contractor shall not be required to replace a plant more than once.

B. PRODUCTS

SOIL PREPARATION MATERIALS

Planting soil shall be 100% natural soil excavated from the planting pits. Before placing, planting soil shall be thoroughly mixed, pulverized, and freed of deleterious material.

Tree pit mulch shall be commercial peat of either sphagnum moss, reed, or sedge peat, taken from a fresh water site, and shall be free from lumps, roots and stones.

PLANT MATERIALS

Plants shall be hardy under climatic conditions similar to those in the locality of the project. Plants shall be typical of their species or variety, and shall have a normal habit of growth. They shall be sound, healthy, vigorous, and well proportioned and well branched. Evergreens shall have full foliate; other plants shall be densely foliated when in leaf. They shall be free of disease and insect pests, eggs or larvae. They shall have healthy, well-developed root systems. Plants shall be free from mechanical injury, cultural injury, injury by animals, and free of noticeable aftereffects of insect attach or blight. Plants shall be equal to or larger than specified sizes.

Balled plants (BB) shall have firm, natural balls of soil, in size as set forth in "Horticultural Standards". Balls shall be firmly wrapped with burlap or equally strong cloth. No balled plant shall be accepted if the ball is cracked or broken either before or during the process of planting. No artificial ball will be permitted.

Container-grown plants shall be grown as scheduled in pots, tubs, cans, or boxes and shall have sufficient roots to hold earth together intact after removal from container without being root-bound.

Bare-root plants (BR) shall be of sizes set forth in "Horticultural Standards", with adequate fibrous roots retained. Roots shall be puddled immediately after they are dug to provide a uniformly thick coating or they shall be packed in moist straw, shingle tow or moss.

MISCELLANEOUS MATERIALS

Stakes for supporting trees under 2” caliper shall be of wood of uniform size, reasonably free of knots, and capable of standing in the ground at least two years, and shall be nominally 1 3/4" by 1 3/4" square or 2” diameter and not less than 48" in length. Drive stakes a minimum of 24” into the ground. Size appropriately to height of plant being supported.

Wire for tree bracing and guying shall be pliable No. 12 gauge galvanized soft steel wire.

Turnbuckles shall be 3" galvanized steel turnbuckles with screw eyes.

Hose shall be 5-ply, fiber-bearing garden hose, not less than 1/2-inch inside diameter.

Anti-desiccant shall be delivered in the manufacturer's containers and used according to the manufacturer's instructions.

Edge all beds not abutting pavement, retaining walls or buildings with 4” galvanized or epoxy coated steel edging

secured with 8” minimum steel stakes. Drive stakes below top of edging.

C. EXECUTION

PREPARATION

Inspect existing topsoil conditions for sufficient topsoil to properly install all plant material shown on the Drawings.

Apply anti-desiccant using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage. If deciduous trees or shrubs are moved in full-leaf, spray with anti-desiccant at nursery before moving and again two weeks after planting.

PLANTING OPERATIONS

Plant pits shall be excavated with vertical sides and in accordance with the following outline:

1. Excavate Tree Pits 2' greater in diameter than the ball of earth or spread of roots of the tree and sufficiently deep to allow for a 6" thick layer of planting soil beneath the ball or roots.

Adjust depth of pits to permit a minimum of 6 inches of planting soil under balls or roots of all plants.

Mark and record pit locations on the Drawings, if pits are prepared and backfilled with the planting soil to grade prior to planting, so that when planting proceeds they can be readily found.

Set plants in center of pits, plumb and straight, and at such a level that after settlement the crown of the plant will be a maximum of 1 inch lower than the surrounding finished grade.

1. Planting soil shall be compacted around bases of balls to fill all voids when balled and burlapped trees are set. All burlap, ropes, or wire shall be removed from the tops of balls.
2. Roots of bare-root plants shall be properly spread out and planting soil carefully worked in among them. Any broken or grayed roots shall be cut off cleanly.
3. Topsoil planting soil around the roots or balls shall be thoroughly compacted and watered. Immediately after plant pit is backfilled, a shallow basin slightly larger than the pit shall be formed with a ridge of soil to facilitate and contain watering. After planting, cultivate the soil in the shrub beds between shrub pits, rake smooth, and neatly outline.
4. Thoroughly soak the backfilled planting pits, when two-thirds filled, with planting soil and fertilizer.

GUYING AND STAKING

Guy and stake all trees 2 inches or more in caliper with three wires and turnbuckles securely anchored to stakes not less than 5 feet from trunk. Cinch tie guy wires to the trunk of the tree with hose to protect from direct contact with guy wires, and tie markers to guys. All trees less than 2 inches in caliper shall be staked.

PRUNING AND MULCHING

Prune each tree and shrub to preserve the natural character of the plant in accordance with "American Standard for Nursery Stock" published by the American Association of Nurserymen. Remove all dead wood or suckers and all broken or badly bruised branches. In addition, 1/4 to 1/3 of the wood shall be removed. Prune with clean, sharp tools. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

Mulch tree pits immediately after planting operations are completed with a 2-inch thick layer of mulch.

WATERING

Water plantings in a satisfactory manner during and immediately after planting for a period of three months or until the Substantial Completion Date, whichever comes last.

MAINTENANCE

Begin maintenance immediately after each plant is planted, and continue until the installation of planting is complete.

Water, mulch, weed, prune, spray, fertilize, cultivate and otherwise maintain and protect plants for a period of three months or until the Substantial Completion Date, whichever comes last.

Reset settled plants to proper grade position, restore planting saucer, and remove dead material. Tighten and repair guys.

Wrap all trees immediately after the trunks have been inspected for injuries, insects, disease, and improper pruning. Trunks of all trees shall be wrapped spirally from bottom to top and shall be adequately secured. Wrapping shall overlap and entirely cover the trunk from the ground to the height of the second branch, and shall be neat and snug. Overlap shall be approximately 1/2 inch.

Correct defective work as soon as possible after it becomes apparent and weather and season permit.

Remove excess soil and debris and repair any damage to structures, etc. resulting from planting operations upon completion of planting and prior to the Substantial Completion Date.

END OF SECTION