
SPECIFICATIONS

FOR

MUNITIONS STORAGE MODULE

BUILDINGS 2580 AND 2581

HILL AFB, UT

Project No. KSRM 020070/71

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MAY 2002

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SECTION 01000 – GENERAL REQUIREMENTS
(Nov 2000)

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PART 1 - GENERAL

1.1 SCOPE

This section is a general section, which applies to all sections. The work encompassed by this specification and noted on the drawings consists of furnishing all labor, equipment, and material unless otherwise stated, to accomplish the construction project.

1.2 SUMMARY

Briefly and without force or effect upon the contract documents, the work of this contract can be summarized as follows:

1. Concrete Apron, precast concrete structure with earth covered roof.
2. Structural steel members with waterproof membrane.
3. Passive ventilation system.
4. Electrical services, interior lighting, lighting protection and communication conduit.

1.3 SITE VISIT

- A. Bidders are responsible for site investigation in accordance with General Provision entitled Site Investigation and Conditions Affecting Their Work (FAR 52.236-3).
- B. If this project involves work in an existing facility, the Contractor is cautioned that this project may present problems which would not be encountered in new construction.

1.4 CONTRACT DRAWINGS AND SPECIFICATIONS

The Contractor must comply with the general provisions entitled Specifications and Drawings for Construction (FAR 52.236-21) and Contract Drawings, Maps, and Specifications (DOD FAR SUP 252.236-7001).

1.5 SUBMITTALS

- A. All shop drawings/submittals as required under this section of this specification will be submitted in two copies.
- B. The submittals shall contain sufficient literature, catalog cuts, brochures etc., to show compliance with the contract specifications and plans. Items of related equipment or materials shall be submitted at one time. Each copy shall be in a separate binder. Mark all submittals to show choices and applicable options.
- C. Submittals shall be given to the Civil Engineering Project Manager as soon as possible, but in no case shall submittals exceed fourteen (14) days after the date of the notice to proceed. No payments will be authorized for materials or work which do not have approved required submittals.

- D. The government will within 14 calendar days return a minimum of one copy of the submittal marked to indicate approval or disapproval. The Contractor shall make any corrections indicated on the submittals. If the Contractor considers any correction to constitute a change to the contract drawings or specifications, written notice will be given to the Contracting Officer. Disapproved items will require resubmission for approval within 14 calendar days of Contractor's receipt. The Contractor will not be allowed to claim for time because of disapproved submittals.
- E. Submit all items called for in the drawings and specifications. The Submittal Checklist at the end of this section is included for the government's convenience and may not include all required items.
- F. Submittals approved by the Contracting Officer shall not relieve the Contractor from responsibility for complying with the requirements of this contract (See FAR 52.236-5). No substitutions for approved items, which meet contract requirements, will be allowed without approval of the Contracting Officer. If submittals show variations from the contract requirements, the Contractor shall describe such variations in writing at the time of submission.

1.6 PROPRIETARY NAMES

Names indicated for colors, textures, patterns and other characteristics of materials; or names identifying specific mechanical and electrical equipment are for selection only. Other manufacturers' materials and equipment are acceptable provided they closely resemble all specified salient characteristics and conform to all other requirements of those products mentioned by name.

1.7 METRIC UNITS

Government construction projects are changing to metric or System of International (SI) units of measurement. The project drawings and specifications may be in SI units. In this case, all field measurements and installation work such as room sizes and stud spacing shall be measured in even SI units. Manufactured materials which are designated as hard conversion must be manufactured to standard SI units or cut to standard SI size. Other materials are referred to as soft conversion. Soft conversion materials manufactured to standard English units may be substituted for items shown on the plans and specifications in SI units. For example, a nominal two-inch pipe may be used for pipe shown as 50 mm pipe. The Contractor is responsible to coordinate all work so soft and hard conversion materials will fit together to provide a finished project.

1.8 STORAGE OF MATERIALS

- A. Store materials so as to avoid hindering the work of other Contractors and to avoid damage or soiling of materials. All materials and equipment shall be stored and handled so as to preclude the inclusion of foreign matter and damage by water or breakage. Store packaged materials in original containers until ready for use. Materials showing evidence of water or other damage shall be rejected and removed from the base. All materials shall be stored as recommended by the manufacturer, unless specifically noted otherwise in the contract documents. Store in accordance with general provisions entitled Operations and Storage Areas (FAR 52.236-10).

- B. When pipe and conduit are stored on the site they shall be stored in racks or blocked to prevent rolling.
- C. When combustible materials are stored on the site they shall be stored in an OSHA approved combustible materials locker at least 50 feet (15 meters) from all buildings unless otherwise specifically indicated by the Contracting Officer.
- D. It is the responsibility of the Contractor to secure all property within the construction site. If government property is included the Contractor must secure it also, and notify the Contracting Officer and the Civil Engineering Project Manager.
- E. The Contractor in the event of storing 1000 rounds or more of fastener gun charges shall obtain an explosive license from the Civil Engineering Weapons Safety Manager in order to comply with regulations.

1.9 CIVIL ENGINEERING EXCAVATION PERMIT

- A. No excavation shall be done prior to receiving a Base Civil Engineering Excavation Permit. Permits may be obtained from the Red Stake Office in Civil Engineering, Building 15 or at the end of this section. If excavation is started without obtaining a permit, the Contractor shall be held liable for repairs of any broken utility lines or other damage resulting from the broken lines.
- B. The Contractor shall request a permit 14 calendar days prior to scheduled start of digging.
- C. Hand digging shall be required to locate utilities shown on the contract drawings, Excavation Permit, or 3 feet (1 meter) on either side of locations identified by Base Maintenance Shops.
- D. The Contractor shall be responsible for identifying all lawn sprinkler system components within the excavation area. Any components damaged during the course of construction shall be repaired by the Contractor at his expense. Any damage to landscaping as a result of contractor damage to sprinkler system components shall also be repaired by the Contractor at his expense.
- E. Protection of existing utilities shall be provided in accordance with general provisions entitled Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements (FAR 52.236-9).

1.10 TESTING

- A. Where specific tests are required by this contract, the Contractor shall notify the Civil Engineering Project Manager 24 hours prior to testing.
- B. The Contractor shall turn in a test report, if required, to the Civil Engineering Project Manager as soon as possible.
- C. The Contractor shall not proceed with any work, which would cover up the work being tested until the work being tested has been approved by the Civil Engineering Project Manager.

1.11 WARRANTIES

This project shall be under warranty as set forth in the General Provision entitled Warranty of Construction (FAR 52.246-21).

1.12 WORK SCHEDULE

- A. All work at Hill Air Force Base shall be accomplished during normal working hours (0730 to 1600 Hours) exclusive of Saturdays, Sundays, and holidays unless other times are approved by the Contracting Officer, or otherwise stated in the contract. Coordinate the work schedule with the Civil Engineering Project Manager.
- B. When working in the aircraft maintenance facilities, the Contractor will be required to work in the close proximity to aircraft and shall use extra caution to insure that construction activities do not endanger aircraft or personnel nor delay aircraft maintenance activities. No work will be allowed over the aircraft. Each aircraft dock affected by this contract will be made available to the Contractor on a random basis as required. Scheduling of this time period is dependent upon completion and movement of the aircraft occupying that dock. The Contractor will be given a tentative schedule of the anticipated availability for each of the affected docks at the preconstruction conference. This schedule will be updated as required to reflect any delays in the anticipated movement of aircraft.
- C. Because of the very strict tool control within the Aircraft Division, all contractor tooling brought in the aircraft work areas shall be marked with contractor identification.

1.13 UTILITY OUTAGES AND TRAFFIC CLOSURES

All utility outages; and traffic closures including streets, parking lots, and pedestrian closures shall be scheduled during off duty hours and weekends unless otherwise approved by the Civil Engineering Project Manager. All outages and closures shall be scheduled as far in advance as possible with the Civil Engineering Project Manager and in no case less than 17 calendar days before the outage or closure. The Contractor shall obtain in writing from the Civil Engineering Project Manager a statement or schedule giving the permissible times for the outage or closure for particular installations and the maximum time allowed for such outage or closure. The Contractor shall strictly observe such schedules and will be held responsible for any violations.

1.14 SAFETY REQUIREMENTS

- A. The Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, (see Contract Clauses ACCIDENT PREVENTION) and the Occupational Safety and Health Act (OSHA) Standards for Construction (Title 29, Code of Federal Regulations Part 1926 and Part 1910 as revised from time to time) and Air Force OSHA standards are

all applicable to this contract. In case of conflict the most stringent requirements of the standards is applicable. If recurring violations and/or gross violation indicate that the safety performance is unsatisfactory, corrective action shall be taken as directed by the Contracting Officer or the Civil Engineering Project Manager.

- B. Any cutting, welding, brazing, or other hot work shall comply with AFI 32-2001/OO-ALC-HAFBS 1, Attachment 16. A USAF Welding, Cutting and Brazing permit, AF Form 592, is required daily for all hot work.
- C. Contractor Confined Space Requirements:

The government's project manager will provide contractors with a copy of the confined space plan for the confined space to be entered. A complete list of confined spaces is available from Ron James, 777-1429, in the Base Safety Office. The owning organization of the confined space has written a confined space plan for each confined space, which they own. This confined space plan identifies the hazards and control of those hazards. The contractor shall obtain a copy of the confined space plan and obtain a confined space permit for the confined space they are to enter. Contractor is responsible for the requirements listed below:

1. Understand the confined space plan. Ask owners of the confined space any questions concerning the plan. Understand any lockout/tagout requirements of the confined space.
 2. Have their own confined space program for entry into the confined space.
 3. Ensure their personnel are confined space trained.
 4. Provide atmospheric testing, entry equipment, and barriers.
 5. Provide own rescue plan.
 6. Inform Air Force facility supervisor when entry is to occur.
 7. Inform Air Force facility supervisor of any hazards introduced into their work area or change of environment, which creates a hazard for Air Force personnel.
 8. Inform Air Force facility supervisor when entry is complete.
 9. Inform Air Force Facility supervisor of any new hazards or changes in environment.
- D. All contractor personnel required to work in areas listed below shall attend a one-hour briefing pertaining to explosive safety. All individuals shall be required to sign a statement of awareness after attending the briefing (sample of which is part of the appendixes). Contractor deliveries or persons visiting the contract site in these areas shall be escorted at all times by an individual who has attended the briefing and signed an awareness statement.
1. Hill AFB MAMS I Area: (Bldg. 797, 930, 931, 932, 933, 935, 939, 940, 945, 950, 955, 960, 965, 970, 975, 980, 981, 982, 983, 984, 985, 988, 1654, 1568, as well as the 1300, 1400, and 2400 zones).
 2. Hill AFB MAMS II Areas: (1600, 1700, 1800, 1900, 2000, 2100, and 2200 zones).
 3. Little Mountain: (Bldg. 1200, and 1204).
 4. Utah Test and Training Range: (Bldg. 40060, 60000, 60015, 60030, and the 30000 zone).
- E. Contractor personnel shall attend the Weapons Safety Briefing and obtain a temporary license before use of powder actuated tools and storage of loads within Hill AFB, Little Mountain, Utah Test and Training Range (UTTR) or other jurisdictional areas. The Base Civil Engineering office will assist the contractors in the filing of the license, which is granted by the Weapon Safety office, OO-ALC/SEW.

1.15 COLD WEATHER PRECAUTIONS

- A. Contractor shall be responsible for proper application of weather sensitive materials and shall not apply any such materials when weather conditions fall below the minimums recommended by the material manufacturer.
- B. Contractor shall cover all concrete installed in weather below 32 0F (0 0C) with approved insulating blankets.
- C. Contractor is responsible in weather below 40 0F (4 0C) that water lines, including fire protection systems, do not freeze.
- D. Contractor shall maintain unoccupied interior portions of building under construction above 50 0F (10 0C). Contractor shall maintain occupied portions of the building under construction above 65 0F (18 0C). This requirement shall replay also in the event that available heating supplied by the building system is rendered inadequate by the Contractor during the course of construction to maintain the above temperature.
- E. The only type of temporary heating devices permitted are UL approved electric heaters. The Contractor shall physically monitor all temporary heating devices at least every four hours. Exception to this requires written approval from the Base Fire Department.

1.16 PROTECTION OF GOVERNMENT PROPERTY AND PERSONNEL

- A. Work areas for this work shall include the following:
 - 1. Actual Construction Site: Area or areas in which the work of the contract is accomplished or performed.
 - 2. Storage Areas: Area or areas used for the storage of materials, devices, appliances, and equipment to be used in the work.
 - 3. Office and Shed Areas: Area or areas for placing or setting of temporary field office, tool sheds or storage sheds.
 - 4. Transportation Areas: Paved, treated or unpaved area or areas that are used for transportation or parking purposes.
 - 5. The entire project shall be fenced with temporary construction fencing at the direction of the Civil Engineering Project Manager.
- B. The Contractor shall conduct his work so the Government property and personnel, other personnel, and work areas, shall be protected at all times from inconvenience, damage of any nature, or injury caused by this work until completion of the contract.
- C. The Contractor shall furnish and spread drop cloths in the work areas as required to protect surfaces, etc.
- D. In the event of damages of any nature caused by this work due to improper protection, precaution of safety measures, such damages shall be repaired or such property shall

be replaced by the Contractor at no expense, cost, or charge to the government. In the event the Contractor does not satisfactorily repair or replace such damage caused by the work of this contract, the government reserves the right to make the necessary corrections and deduct from the contract price the cost to the government for inconveniences, labor, materials, etc. involved. Reference General Provisions Protection of Existing Vegetation, Structures, Equipment, Utilities and Improvements (FAR 52.236-9).

- E. The Contractor shall furnish, place, and maintain all required barricades as directed by the Safety Office and the Civil Engineering Project Manager, and access drives and doors will remain clear at all times.
- F. It shall be the responsibility of the Contractor to prevent any damage to existing pavements beyond the limits of indicated pavement removal. Existing pavements that are to remain and are damaged by the Contractor shall be replaced in kind or repair as directed by the Contracting Officer at no expense to the government. Road/lane closures-traffic interruption. The Contractor will submit for approval 15 days prior to commencing work a barricade and sign plan clearly showing work area, location, and type of sign to be placed for rerouting traffic. Part VI, The Manual on Uniform Traffic Control Devices will be used for traffic signing and barricades.
- G. The Contractor shall conduct his operations so as to offer the least possible obstruction and inconvenience to public traffic, and all traffic shall be permitted to pass through work with as little delay as possible. Where the nature of construction operations in progress and the equipment and machinery in use are of such character as to endanger passing traffic, the Contractor shall provide such lights and signs, erect such fences or barriers, and station such guards as may be necessary to give adequate warning and to avoid damage or injury to passing traffic. Signs, flags, lights and other warning and safety devices shall conform to applicable city, county, and state requirements

1.17 HOUSEKEEPING AND DAILY CLEANUP

The Contractor shall keep the total construction site, structures, and access ways free of debris and obstructions at all times. Work will not be allowed in those areas that, in the opinion of the Civil Engineering Project Manager, have unsatisfactory cleanup and housekeeping at the end of the preceding days' normal work shift. At least once each day all areas shall be cleaned by the Contractor.

1.18 COVERING OF DEBRIS

The Contractor and Subcontractor shall be responsible to cover all loads of debris before hauling them off base. The Contractor and Subcontractor shall provide a covering to keep the debris on the truck; however, in the event debris does fall out of the truck while hauling they shall immediately clean up all debris.

1.19 REMOVALS AND SALVAGE

- A. Contractor shall be responsible for the removal and/or dismantling of items which are required for proper completion of work as applicable to each section.

- B. All materials and equipment resulting from this work not designated for reuse in new work nor designated to be salvaged for the government, become property of the Contractor, and shall be removed from site as the materials and equipment are accumulated and disposed off base. All excavated material (dirt, asphalt, concrete, etc.) and construction/demolition debris shall be managed in accordance with paragraph ENVIRONMENTAL PROTECTION.
- C. All fire or security panels manufactured by Honeywell or panels with the capability of emulating Honeywell Delta 1000 protocol will be turned over to the Civil Engineering Electronics Section (Bldg. 20, east end) for proper disposition. Cabinets will be delivered with all electronics and internal wiring intact. However the batteries in the cabinets will be removed by the Contractor and disposed of as hazardous waste as called out in subparagraph All Hazardous Wastes in paragraph Environmental Protection.

1.20 FINAL CLEANING

- A. Execute prior to final inspection.
- B. Clean surfaces exposed to view. Remove temporary labels, stains, and foreign substances: polish transparent and glossy surfaces, wet mop tile or sealed concrete floors, vacuum carpeted floors, broom clean other floors. Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment. Any additional final cleaning as specified in other sections.
- C. Clean site of all construction related and project related debris.
- D. Remove waste and surplus materials, rubbish, and construction facilities from the work areas and the site.

1.21 OPERATION & MAINTENANCE (O&M) MANUALS AND TRAINING

- A. Provide O&M Manuals as required by other sections of this specification. O&M Manuals to be submitted and approved.
- B. Provide O&M Training as required by other sections of this specification.

1.22 CLOSEOUT PROCEDURES

- A. The Contractor shall include the following items as a "Contract Close out" line item on both the Contract Progress Schedule (AF-3064) and Contract Progress Report (AF-3065): O&M Manuals, Training, Testing and Balance Reports, Warranty Information and Complete Record Drawings.
 - 1. For projects up to \$100,000.00, the progress schedule and progress report will show 5.0% for submission of these items.
 - 2. For projects between \$100,000.00 and \$500,000.00, the percentage will be 1.0%
 - 3. For projects over \$500,000.00, the percentage will be 0.5%.
- B. The contract cannot be closed out nor final payment made until these items have been received from the Contractor.

- C. The Contractor shall have turned in all Test & Balance Reports, O&M Manuals and shall have completed all training prior to the prefinal inspection.
- D. The contract cannot be closed out nor final payment made until these items have been received from the Contractor.
- E. The Contractor shall notify the Contracting Officer 5 working days in advance that his contract is substantially complete and is ready for a prefinal inspection. Contractor shall submit in writing a list of items to be completed or corrected.
- F. Upon completion of final inspection, the Contractor shall have five working days to submit warranty information and provide complete record drawings. The Contracting Officer will notify the Contractor in writing of additional items to be completed or corrected.
- G. Contractor shall remedy deficiencies and notify the Contracting Officer a minimum of 5 working days in advance of the date his contract will be completed and ready for a final inspection. Contractor shall send a second notice of substantial completion and the work will be reinspected.
- H. Upon completion of the final inspection, the Contracting Officer will notify the Contractor in writing of any deficiencies remaining on the project.

1.23 RECORD DRAWINGS

- A. Maintain a complete set of either blue-line or black-line prints of the contract drawings and shop drawings for record mark-up purposes throughout the contract time. Contractors that electronically bid this project, shall produce one set of blue line drawings to meet this requirement. The contractor shall process the drawings whenever working on site and mark-up these drawings in red, during the course of the work to show both changes and the actual installation in sufficient detail to form a complete record of work accomplished. Particular attention should be given to work which will be concealed and difficult to measure and record at a later date, and work which may require servicing or replacement during the life of the facility. The individuals marking prints will sign and date each mark-up. The record drawings will be bound in manageable sets covered with durable paper and labeled to show project title and number.
- B. Upon completing the work under this contract, the Contractor shall furnish a complete set of as built shop drawings in mylar reproducible and electronic format. These drawings shall show all changes and revisions made on the job.
- C. The governments inspector will review the contractor's record drawings when verifying the performance shown by progress reports. If the record drawings are not current the progress report will be adjusted downward to reflect the contractor's non-compliance. Record drawings will be submitted within five working days after substantial completion. Final payment will not be authorized until complete and accurate record drawings are accepted by the Civil Engineering Project Manager.

1.24 UTILITY LINE MARKING

- A. Contractor shall provide and install a trace wire of #14 insulated copper wire within one foot of all new utilities placed underground at Hill Air Force Base. If length of new utility is 500 feet or less the Contractor shall install one terminal box of 2 ½" diameter pipe at each end of the wire marking the utility location. If length of new utility is greater than 500 feet, the Contractor shall place terminal boxes at 500 feet intervals. Terminal boxes (Handley Industries or approved equal) shall have a metal screw-on type lid. The terminal box shall be encased in an 18" diameter by 12" deep concrete cylinder. The terminal box lid shall be flush with the top of the concrete cylinder and the top of the concrete cylinder shall be flush with adjacent pavement or 2" above the adjacent ground elevation. The trace wire shall have a metal identification tag attached to the wire at each terminal box. The tag shall be engraved with the type of utility and for pipe lines the tag shall be engraved with the pipe size.
- B. The Contractor shall provide a detectable warning tape for all underground utilities. The warning tape shall be an acid- and alkali-resistant polyethylene film manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick minimum, with a metallic core protected from corrosion and detectable by metal detector when tape is buried up to 30 inches (750 mm) deep. The warning tape shall be continuously incised with a description of utility. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.
1. Tape Colors: Provide tape colors to utilities as follows:
 - a. Red: Electric
 - b. Yellow: Gas, oil, steam, and dangerous materials.
 - c. Orange: Telephone and other communications.
 - d. Blue: Water systems.
 - e. Green: Sanitary Sewer, Storm Sewer and Industrial Waste systems.

1.25 ENVIRONMENTAL PROTECTION

The Contractor is required to comply with all applicable local, state, federal, and Air Force laws and regulations dealing with environmental and workplace management and protection. In the event of a conflict between any laws or regulations, the most stringent shall apply. These items include, but are not limited to, the following:

- A. Vehicles and other powered equipment will meet local (Davis County) air quality regulations for emissions. They will be mechanically sound and have all seals, grease rings, and other containment systems in place to ensure against leakage. Drip pans will be maintained such that overflow and spills do not occur. There will be no activities for equipment maintenance including oil changes, filter replacements, or hydraulic equipment repair performed on base.
- B. All solid waste shall be collected and disposed of on a daily basis. There will be no accumulation of solid waste unless properly containerized or put within a fenced area to prevent material being blown about by the wind. No liquids will be put into base dumpsters. This includes paints, oils, chemicals, compressed gas, or pesticides.
1. Paint Cans. Only empty paint cans shall be allowed in dumpsters. A paint can is considered empty if paint comprises less than 1 inch or 3% by weight of the total capacity of the container, whichever is less. If the residue in the container exceeds these limits, contact EMC at 777-3124 for disposal instructions.
 2. Asphalt debris shall be managed by disposing in an off-base Class I, II, III, or V permitted landfill.
 3. Asphalt debris shall be managed by reusing as road base on Hill AFB.

4. Asphalt debris shall be managed by disposing in the asphalt storage cell at the Hill AFB Class IV landfill. See attached map at the end of this section. Primarily asphalt with minimal amounts of soil is allowed in the asphalt cell. The contractor shall contact the landfill superintendent at 777-2929 to gain access, to have their loads recorded, and to receive instructions for dumping.
 5. Concrete and Excavated soils, that have been determined by the pre-contract laboratory analysis to be "clean", shall be managed by depositing in the Concrete/Soil Cell at the Hill AFB Class IV landfill. See attached map at the end of this section. Only concrete and soil are allowed in this cell. The contractor shall contact the landfill superintendent at 777-2929 to gain access, to have their loads recorded, and to receive instructions for dumping.
 6. Concrete and Excavated soils, that have been determined by the pre-contract laboratory analysis to be "clean", shall be managed by disposing in an off-base Class I, II, III, IV or V permitted landfill.
 7. Wood that is recyclable shall be managed by disposing in an off-base Class I, II, III, IV or V permitted landfill or in the Wood Cell at the Hill AFB Class IV landfill. See attached map at the end of this section. Only recyclable wood which may contain nails or staples but not bolts or brackets is allowed in the Wood Cell. The contractor shall contact the landfill superintendent at 777-2929 to gain access, to have loads recorded, and to receive instructions for dumping.
 8. All other debris excluding concrete, asphalt, excavated soil, wood and hazardous or special wastes--such as asbestos, contaminated soils, paints, or solvents--shall be managed by disposing in an off-base Class I, II, III, IV, or V landfill.
 9. Other solid waste questions. Other questions regarding the disposal of solid waste should be directed to the Civil Engineering Project Manager.
 10. Upon prior approval from EM hazardous waste must be disposed of at the hazardous waste control facility, bldg 514.
- C. All hazardous wastes such as sandblast media, chlorinated solvents, paint thinners, and fuels will be labeled and an inventory management system initiated to ensure timely removal and proper disposal. There will be no on-base disposal allowed, including use of drains (sanitary, storm, or industrial).
1. All drums must be labeled with a hazardous waste label. The proper DOT shipping name, UN or NA, EPA waste number, generator information, and accumulation start date on the label must be filled out. The label must be placed in the upper third of the drum.
 2. All drums used to store hazardous waste must be nonleaking and safe to handle. Drums that are rusty, dented, or leaking should be overpacked. Drums and/or overpacks must be purchased by the Contractor. All drums purchased by the Contractor must be DOT specification numbers 5B, 17E or 17H. The specification numbers are stamped on the bottom of the drum.
 3. Drums filled with hazardous waste must be inspected weekly for leaks. The Contractor will obtain from Environmental Management (EM), north end of Building 5, and fill out a generator's inspection checklist each week the drums are in storage (up to 90 days). Completed checklists must be forwarded to EM every Friday until the drums are properly disposed of by the Contractor.
 4. Hazardous waste drums must be stored in an area authorized by EM. In general, the area must have a containment system, be secure, and have signs placed around it that say: "Hazardous Waste. No Trespassing."
 5. Hazardous waste drums can only be stored for 90 days after the accumulation start date. Drums will be kept closed except when adding or removing waste.
- D. Fuel storage will be limited to 110 gallons (416 liters). Siting of this will be approved by the Base Fire Department and the Environmental Management Office.

- E. Storage of oils, greases, chemicals, or other liquids will require a fully contained facility for spill prevention and security. A minimum of 40 pounds (18 kg) of absorbent material per 44 gallons (167 liters) of chemical/oil/grease will be on hand for spill control.
- F. All spills shall be reported by dialing 911 and giving information as to spill location, type of material and estimated quantity, and if the spill is contained. The Contractor will ensure appropriate personnel protective equipment (PPE) is available to take care of spill cleanup and handling of residue.
- G. Spray painting shall utilize high-transfer efficiency equipment with low-volatile organic compound (low-VOC) paints or water base paints. The VOC content of low-VOC paint shall be 3.5 pounds per gallon or less for primers, top coats, and specialty coatings--for clear coats, 4.3 pounds or less. If a low-VOC paint is not available for the application, a paint waiver shall be obtained from EMC by contacting the Civil Engineering Project Manager. Uncontrolled spray painting with high-VOC paints shall not be performed.
- H. Contractor sites will be maintained at all times. Damage due to erosion and control of fugitive dust will be the responsibility of the Contractor. An on-site review will be conducted by the Contracting Officer, the Construction Engineer, and the Environmental Management Office (EMO) prior to use of any location for contractor setup. A follow-up program for site overview will be maintained by all parties. Release of the site by the Contractor will be accompanied by a final site review, at which time site deficiencies will be noted. The Contractor will have 14 calendar days to correct deficiencies. Final contract payment will be withheld pending completion of the deficiency list.
- I. Asbestos and Lead-Based Paint: The Contractor is cautioned that materials in and around this project may contain asbestos or be coated with Lead-Based Paint (LBP). The government will make every effort to locate and identify all Asbestos Containing Materials (ACM) and LBP prior to bidding, however this is not always possible. These materials are often hidden and cannot be discovered until after demolition has begun. The failure of the government to identify all ACM and LBP in no way relieves the Contractor from his legal obligation to comply with state and federal regulations regarding the handling of asbestos, lead, or LBP. If suspected asbestos containing materials or LBP surfaces are encountered, immediately cease work and notify the Contracting Officer and the project manager immediately. Do not conduct or continue with any work that will violate any Air Force, local, state or federal regulations regarding asbestos, lead, or LBP. If suspected materials or surfaces have not been disturbed, secure and post signs in the area where the materials are located to ensure that they are not disturbed. If the suspected materials have already been disturbed, secure and post signs in the area where the material was originally located, any areas to which materials have been moved, and any containers that suspect materials may have been placed in. Take any and all necessary steps to ensure that materials are not further disturbed, moved, or disposed of until directed to do so by the Contracting Officer. Failure to notify the government promptly, or failure to comply with state and federal regulations will be grounds for termination of their contract and may result in other appropriate civil and/or criminal actions. "The Contractor will be fully responsible for any and all fines or other penalties resulting from his acts and /or omissions pursuant to law and regulation. At the Pre-Construction Conference, the contractor will be required to sign the "Contractor's Notification of Hazardous Materials Requirements" at the end of this Section.

- J. Standards for Demolition and Renovation: For demolition and renovation the contractor shall comply with 40 CFR 61.145 and the Utah Administrative Code R307-801. The contractor shall complete the applicable Utah Division of Air Quality notification form with the assistance of the government's project manager and the Base Asbestos Manager. The contractor shall submit the applicable form to the State with a copy sent to the government's Project Manager. Forms are available at the web site www.eq.state.ut.us/eqair/haps/asbestos/forms.htm.
- K. All tanks used for fuel storage must have spill containment for 110% of stored fuel. Any tanks needed for chemicals, oils, and other liquids must have spill containment for 110% of stored product.
- L. If at anytime, an authorized inspector for EM feels that regulatory requirements listed above are not being followed, EM reserves the right to notify the Contracting Officer and recommend corrective action.
- M. Banned Ozone Depleting Substances (ODS): Heating, Ventilating and Air Conditioning equipment which use chlorofluorocarbon (CFC) refrigerants are strictly prohibited. This includes but is not limited to R-11, R-12, R-13, R111, R-112, R-113, R-114, R-115, R-211, R-212, R-213, R-214, R-215, R-216 and R-217. Fire protection systems using Halon 1211, 1301 or 2402 are also prohibited. Other substances banned from use on the work site include carbon tetrachloride, methyl chloroform and methyl bromide.
- N. Excavation disturbing five acres or more of land shall be covered by an erosion control plan. The Contractor shall submit a notice of intent to the Division of Water Quality with a copy of EMC through the Civil Engineering Project Manager.
- O. All items of geological or archeological interest such as fossils, articles of value or antiquity and structures or other remains or relics discovered during excavation or surface work are and will remain the property of the Air Force. Upon discovery of an artifact (historic or pre-historic in nature) or human remains, all work shall cease and the cultural resource officer in the Environmental Management Directorate shall be notified through the Civil Engineering Project Manager. Work will only continue when the Contractor is given the go ahead by the cultural resources officer through the Civil Engineering Project Manager. The Contractor shall take all reasonable precautions to prevent unauthorized removal of or damage to any such discovery.

1.26 CONTRACTOR BASE IDENTIFICATION CREDENTIALS

- A. The procedure for obtaining base identification passes for contractor personnel to work on any Air Force Material Command (AFMC) base shall be as follows:
1. The Contractor shall submit a written request on company letterhead stationary, if available, to the Contracting Officer specifying:
 - a. Contract number.
 - b. Location of work site:
 - c. Date entry to the base must begin and contemplated termination date of entry.
 - d. Names of contractor and subcontractor employee requiring access to the base.
 - e. The name of the individual who will submit the Request of Identification Credentials for each employee for whom identification credentials are needed.
 2. The Contracting Officer will:

- a. Endorse the request.
 - b. Attach a copy of the contract cover page and any other pages that provide performance information, such as the need for and duration of access to the work site.
 - c. Forward this request to the Security Police, Pass and Identification Office of the installation where the work is to be performed.
 - d. Provide blank AFMC Form 496 and AF Form 2586 to the Contractor.
3. The Contractor will be required to complete and submit AFMC Form 496, Request for Identification Credentials, for each of the firm's employees and for each subcontractor employee who must have access to the installation.
 4. The Contractor shall also request AF Form 75, Visitor/Vehicle Pass or DD Form 2220, DoD Registered Vehicle, for vehicle decals when the Request for Identification Credentials is submitted. To obtain the vehicle decal from the Security Police, Pass and Identification Office, the Contractor shall produce:
 - a. A valid drivers license.
 - b. Proof of financial responsibility or insurance which meets the minimum requirements of the contract clause entitled "Required Insurance."
 - c. Current vehicle registration.
 5. The Security Police, Pass and Identification Office, upon issuance of the appropriate badge for AF Form 2586, will provide a copy of the completed AF Form 2586 to the individual receiving the badge.
 6. Follow the guidance in AFI 31-209, The Resources Protection Program, when work under this contract requires unescorted entry to controlled areas. The Contractor will request completion of an AF Form 2586, Unescorted Entry Authorization Certificate for each prime contractor employee and subcontractor employee for which a controlled area badge is required. Contractor employees with controlled area badges are required to escort contractor employees without badges, at all times, in and out of controlled areas. If it becomes necessary to establish a free zone for the Contractor, it must be approved in writing by the installation commander. The free zone must have clearly defined boundaries. It is recommended the free zone begin at some point in the boundary of the controlled area, which enables entry by the Contractor and other authorized personnel. The free zone must be closed during non-duty hours. The boundaries of the free zone must be under surveillance by the OPR for the area or designated responsible activity. See AFH 31-223, page 17 for further guidance.
 7. When contract performance requires unescorted entry (no access to classified information) to a "Restricted Area" on a military installation, contractor personnel requiring unescorted entry must meet the investigative requirements of AFD 31-5, USAF Personnel Security Program. Contractor employees not meeting these requirements will be provided escort as determined by the Contracting Officer in coordination with the Chief, Security Police Division of the military installation involved.
 8. No Foreign Nationals may be employed by the Contractor without first clearing through the Foreign Disclosure Office, 777-6858.
- B. Contractor employees, at all times while on a military installation, shall wear visible contractor-provided identification either as a part of, or attached to, their outer clothing. The identification shall clearly identify the individual as being a contractor employee.
- C. During performance of the contract, the Contractor shall be responsible for obtaining required identification for newly assigned personnel, and for prompt return of credentials and vehicle registration decals to the Security Police, Pass and Identification Office, for any employee who no longer requires access to the work site.

- D. At the termination or completion of the contract, or upon the expiration of credentials (if any such expirations are specified), the Contractor must be sure that all base identification credentials and vehicle registration decals for all contractor and subcontractor employees are returned to the Security Police, Pass and Identification Office.
- E. Prior to submitting an invoice for final payment, the Prime Contractor shall obtain a clearance certification from the issuing Pass and Identification Office which states that all base identification credentials and vehicle decals have been returned or "accounted for." This certification shall be attached to the final invoice at the time of submittal for payment. Failure to comply with these requirements will result in withholding final payment until compliance is effected.
- F. If it becomes necessary for the Contractor to enter any unmanned base entry gate, they must first contact 75 SFS/SFO at 777-5531. If the Contractor assumes custody or control of a particular gate they will insure:
1. Only cleared contractor personnel for that respective project gain access to the base through that gate.
 2. Lock and Key Control will be established in such a manner as to clearly define an audit trail of who have keys to the gates and the times the gates are opened and closed, 24 hours a day.

PART 2 - PRODUCTS (N/A)

PART 3 - EXECUTION (N/A)

PART 4 - APPENDIXES

4.1 SUBMITTAL CHECKLIST

SECTION	SUBMITTAL ITEM REQUIRED	CATALOG CUTS	PRODUCT DATA	SCHEDULES	SHOP DRAWINGS	MATERIAL CERTIFICATES	SAMPLES	COLOR SELECTION	CONTROL DIAGRAMS	WIRING DIAGRAMS	TEST REPORTS	O&M MANUALS	MIX PROPORTIONS
2203	Bill of Lading for Asphalt												
2204	Mineral Aggregates and Fill					X					X		
2204	Asphalt Mix Design												
2204	Source Aggregate Sample Report												
2222	Structural Excavating and Backfilling					X							
2225	Trench Excavating and Backfilling					X					X		
2505	Field and Laboratory Control Test Report		X			X					X		
2508	Material Certificates		X										
2509	Material Certificates					X							
2510	Mix Design												X
2510	Compaction Effort Tolerances			X									
2510	Control Testing Results										X		
2936	Seeding					X							
3100	Concrete Formwork				X								
3200	Concrete Reinforcement				X	X							
3251	Expansion and Contraction Joints		X			X	X						
3300	Cast-in-Place Concrete					X							X
3345	Concrete Finishing		X										
3410	Structural Precast Concrete		X		X						X		
5120	Structural Steel		X		X						X		
5500	Miscellaneous Metal		X		X		X				X		
7110	Sheet Membrane Waterproofing		X										
10200	Louvers, Vents and Fusible Link		X		X								
12670	Entrance Mats and Frames		X		X		X						
16010	Shop Drawing and Materials Lists		X		X								
16010	Material and Equipment Schedule	X		X									
16050	Basic Electrical Materials and Methods		X										
16170	Operation and Maintenance Data		X							X		X	
16170	Record Documents								X		X		
16170	Certificate of Compliance							X					
16555	Transient Voltage Suppression					X							
16390	Qualifications												
16220	Transformers					X							
16610	Lightning Protection		X			X			X		X		

4.2 BASE CIVIL ENGINEERING EXCAVATION PERMIT

BASE CIVIL ENGINEERING EXCAVATION PERMIT			
1. DATE SUBMITTED	2. REQUESTER'S NAME / PHONE	3. WORK LOCATION OR AREA	
4. DATE PERMIT REQUIRED (ALLOW 14 DAYS)	5. SITE VISIT REQUESTED <input type="checkbox"/> YES <input type="checkbox"/> NO	6. JO # / WO # / CONTRACT PROJECT #	
7. UTILITY(IES) TO BE INSTALLED		8. CONTRACTOR / SITE PHONE	
9. DESCRIPTION OF WORK TO BE ACCOMPLISHED (INCLUDE A SKETCH AND/OR SITE PLANS)			
APPROVED / DISAPPROVED FOR <input type="checkbox"/> 30 DAYS <input type="checkbox"/> 60 DAYS <input type="checkbox"/> 90 DAYS ONLY			
RESPONSIBILITY STATEMENT			
The responsible individual's signature indicates they understand the map and marked utilities. In case of the responsible individual being a contractor, their signature denotes acceptance of financial and all other responsibilities relating to a case of any or all danger to utilities and personnel as identified by the Red Stake office. It is further understood all line strikes, however minor, will be brought to the attention of Red Stake. ***This permit is required to be on hand, on site, during excavation.***			
*HAND DIGGING IS REQUIRED WITHIN A MINIMUM OF 2 FEET OF ALL UTILITIES EXCEPT COM.(ORANGE) THEY REQUIRE 3 FEET! **PLEASE REMOVE ALL MARKINGS AFTER WORK IS COMPLETE.			
SHOP/CONTRACTOR _____ * DATE _____			
CECOC (RED STAKE) _____ DATE _____ 777-1995			
FOR RED STAKE USE ONLY			
75 CS	777-6464	FOR ALL COM & LANS	SIGNATURE OF LOCATOR
777-3741			
CABLE TV	776-0600	CALL 2 DAYS AHEAD	
BLUE STAKE	532-5000 1-800-662-4111	CALL 2 DAYS AHEAD (FOR ALL COMMERCIAL PHONES)	
IN CASE OF EMERGENCY PLEASE CALL 777-1856 OR 777-2158			

75 CEG/CECOC FORM 12 JUNE 2000

OVER ->

ADDITIONAL REMARKS (PRECAUTIONARY MEASURES TO BE TAKEN)

GENERAL REQUIREMENTS

01000 -18

IN CASE OF EMERGENCY PLEASE CALL 777-1856 OR 777-2158			
UTILITY COLOR CODES			
RED	ELECTRIC POWER LINES, POWERED CONDUITS	GREEN	STORM & SANITARY SEWERS, DRAIN LINES
ORANGE	COMM LINES, CABLES, & UNKNOWNNS	BLUE	POTABLE WATER, IRRIGATION, & SLURRY LINES
YELLOW	GAS, OIL, PETROL, & OTHER GASEOUS MATERIALS	WHITE	DIGGING SITE BOUNDARIES, TRENCH LINES

75 CEG/CECOC FORM 12 JUNE 2000 (REVERSE)

4.3 CONTRACTOR'S NOTIFICATION OF HAZARDOUS MATERIAL REQUIREMENTS

CONTRACTOR'S NOTIFICATION
OF
HAZARDOUS MATERIAL REQUIREMENTS

1. I hereby acknowledge and attest to, my having thoroughly read, and understood, the requirements for me, my employees, my sub-contractor, my sub-contractor's employees, and all those having any involvement with the work called out in this contract. In so doing have no reservations, concerns or questions of the policies set forth in this document, regarding the prevention of exposure to, or contamination by, the hazardous materials described in this document, I do so attest by my signature below.

2. The hazardous materials are as follows:

- a. Asbestos OSHA - 29 CFR 1926.1101
- b. Ceramic Fibers (Respirable Size) OSHA - Hazard Communication Standard
- c. Glasswool (Respirable Size) EPA - Clean Air Act
OSHA - Hazard Communication Standard, "Particulate Not Otherwise Regulated"
- d. Lead OSHA - 29 CFR 1926.62

3. Any facility that was constructed prior to 1984 shall be considered suspect of containing these materials.

4. In the event of uncovering suspected hazardous materials, the Contractor shall stop all work and immediately contact the Project Manager. The Contractor shall adhere to Section 01000 General Requirements and the direction of HAFB officials concerning these materials.

5. The Contractor shall not continue on his own accord without having the suspect materials identified by HAFB (Bio-Environmental X71171 or X79036) officials.

Signed: _____ Title: _____

Date: _____

Witnessed: _____ Date: _____

Witnessed: _____ Date: _____

4.4 MINIMUM EXPLOSIVE SAFETY AWARENESS

- A. When working in the explosive areas (MAMS I, MAMS II, as well as areas of the Airfield, Little Mountain and UTTR as described in Paragraph 1.15, sub-paragraphs D1, D2, D3, and D4, special requirements apply:
 - 1. Smoke only in posted "Designated Smoking Areas."
 - 2. "Hot Work" (welding, cutting, brazing, open flames, spark producing equipment, high heat appliances, tools, etc.) requires AF Form 592 issued by the HAFB Fire department before work begins.
 - 3. A speed limit of 25 mph shall be enforced.
 - 4. Park vehicles 50 feet from any explosive facility on a surface free of combustibles. If the vehicle is not required as part of the work effort, it shall be parked in established parking areas or lots.
 - 5. The use of cell phones pagers or radios shall not be used within 10 feet of any explosive facility.
 - 6. Explosive laden vehicles have the right of way at all times.
 - 7. Roads posted "Explosive Operation in Progress" shall not be used.
 - 8. Each work site shall have, as a minimum, two Type ABC fire extinguishers.
 - 9. Work on facilities, or in areas with explosives requires the prior approval of the facility supervisor and OO-ALC/SEW. Unless the explosives have been removed by USAF personnel before work begins.

- B. When working in the explosive areas, use only the minimum number of workers to accomplish the job. Remain in the explosive areas for the minimum amount of time to complete the job. Leave the explosive areas for breaks and lunches. The cardinal rule for the explosive areas: Limit exposure to a minimum number of persons, for a minimum amount of time, to the minimum amount of ammunition and explosives consistent with safe and efficient operations.

- C. Emergency procedures in the event of accident, fire, and/or electrical storm:
 - 1. Maintain a capability to communicate with OO-ALC emergency services (telephone 911, cellular phone 777-1911, radio with frequency authorized by the Project Manager or other suitable means).
 - 2. Maintain a capability to be contacted by emergency services or the Project Manager.

- D. Only tasks consistent with the contract shall be accomplished in explosive areas.

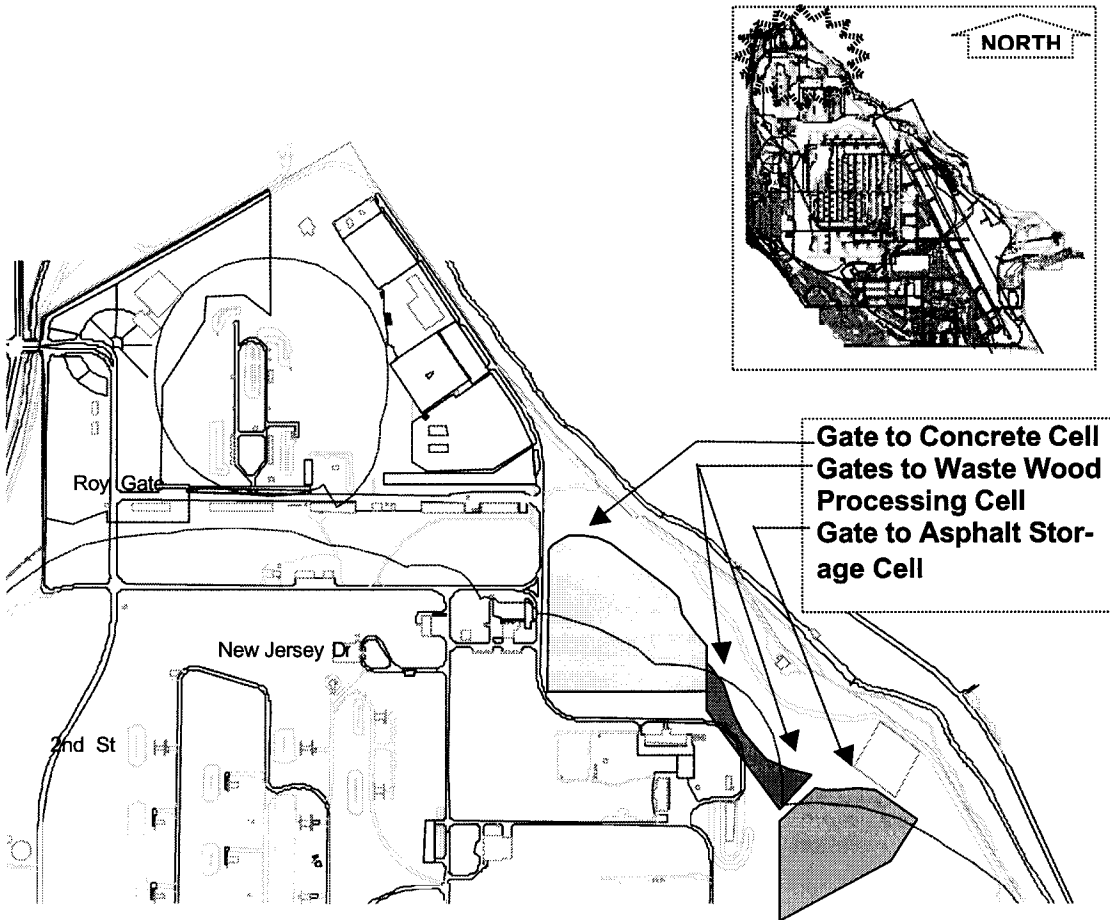
I have read and completely understand the above minimum safety requirements and shall comply as they apply to this contract.

PRINTED NAME: _____

SIGNATURE: _____

DATE: _____

4.5 HILL AFB LANDFILL MAP



End of Section 01000

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Select fill - pea gravel, sewer rock, subbase course and base course
- B. Common fill - borrow and sand
- C. Topsoil

1.2 RELATED SECTIONS

- A. Section 02222 - Structural Excavating and Backfilling

1.3 REFERENCES

- A. ASTM C 131: Standard Test Method for resistance to Degradation of Small-Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- B. ASTM C 136: Standard Method for Sieve Analysis for Fine and Coarse Aggregates.
- C. AASHTO M 145: Recommended Practice for the Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01000.
- B. Samples and Testing: Testing shall be the responsibility of the Contractor and shall be performed by an established commercial testing laboratory subject to approval by the Contracting Officer. Quality control testing shall be performed per the Construction Control Manual. Field density and moisture content tests shall be performed in sufficient number to insure that the specified density is obtained per the Construction Control Manual. Density tests shall be performed in accordance with ASTM D 1556. Field density test results shall be provided in writing to the Contracting Officer.
- C. Materials Source: Submit name of imported materials suppliers. Provide materials from same source throughout the work. Change of source requires the Contracting Officer's approval.

1.5 ACCEPTANCE

- A. Acceptance shall be determined by Contracting Officer based upon aggregate gradation and a test lot size of 1 subplot of 500 tons or portion thereof plus any additional subplot of 500 tons or portion thereof placed in any one week.
- B. Contracting Officer reserves the right to select and test embankment on a random basis from any location in the Work, or from the source.

1.6 DEFINITIONS

- A. Combined Aggregate Target: The ideal gradation of a combined aggregate which is approved by Contracting Officer. The ideal gradation shall be a smooth curve within the limits of the Master Grading Band.
- B. Master Grading Band: The allowance gradation limits for a Combined Aggregate Target.

**SECTION 02204
MINERAL AGGREGATES AND FILL**

PART 2 - PRODUCTS

2.1 SELECT FILL AND MATERIALS

- A. Clean, hard, tough, durable, and sound mineral aggregates that consists of crushed stone, crushed gravel or crushed slag; free of deleterious and organic matter; and complies with the following:
1. Rodded Weight: Not less than 75 pounds per cubic foot.
 2. Material Passing No. 200 Sieve: Nonplastic.
 3. Aggregate Wear Under ASTM C 131: Less than 50 percent.
 4. Master Grading Band Limits: Table No. 02204-2.1.
 5. Target Grading Band Limits: Table No. 02204-2.1.

TABLE No. 02204-2.1

MASTER GRADING BAND LIMITS¹				
SIEVE SIZE	UNTREATED BASE COURSE²		UNTREATED SUBBASE COURSE	
	Grade 1-1/2 Min	Max	Grade No. 2 Min	Max
2"	-	-	100	-
1-1/2"	100	-	-	-
3/4"	81	91	-	-
1/2"	67	77	-	-
No. 4	43	53	-	50
No. 10				
No. 16	23	29	-	30
No. 40				
No. 200	3	5	-	5
0.02 mm				3

¹ Untreated Base Course: Based on fine and coarse aggregate having approximately the same bulk specific gravities.

² Plasticity index of 6 maximum.

2.2 COMMON FILL

- A. Borrow: Classifications A-1-a through A-4 of AASHTO M 145.
- B. Granular Borrow: Classifications A-1-a, A-1-b, A-2-4, or A-3 of AASHTO M 145. The material meets the design CBR or R value for suitability of source and not for project control testing.
- C. Granular Backfill Borrow: Classification of A-1 of AASHTO M 145, well graded with a particle size of 2 inches maximum in accordance with Table No. 02204-2.2.
- D. Sand: Natural river or bank sand, free of loam, friable, deleterious or soluble materials and organic matter, graded in accordance with Table No. 02204-2.2.

TABLE No. 02204-2.2

SAND				
SIEVE SIZE	SAND		GRANULAR BORROW	
	Min	Max	Min	Max
2"	-	-	-	100
1"	-	-	40	80
3/8"	100	-	-	-
No. 40	-	-	5	60
No. 200	-	15	0	10

2.3 TOPSOIL

- A. Native or approved imported material which is fertile, friable, natural loam containing humus and capable of sustaining vigorous plant growth with pH range of 5.5 to 7.5.
- C. Furnish topsoil that is free of admixture of subsoil and reasonably free of stones larger than 2 inches, lumps, clods or hard earth, plants or their roots; sticks, and other extraneous matter, and contains no noxious weeds or their seeds.

2.4 IGLOO COMPACTED COVER – AFMN 91-201 Sec. 3.12.4 (7 March 2000)

- A. Select cohesive earth fill, free from unhealthy organic matter, trash, debris, and frozen material. Do not use stones heavier than 10 pounds or larger than 6 inches. Compact and prepare the surface to keep structural integrity and control erosion.

2.5 SOURCE QUALITY CONTROL

- A. Stockpile in sufficient quantities to meet Progress Schedule and requirements.
- B. Separate differing materials to prevent mixing.
- C. Maintain optimum moisture content of stockpiles.
- D. Direct surface water away from stockpiles to prevent erosion or deterioration of materials.

2.6 INSTALLATION

- A. Backfilling for utilities; Section 02225
- B. Backfilling for structures; Section 02222

2.7 CLEANUP

- A. Remove stockpiles from the site. Grade site surface to prevent free standing surface water.
- B. Leave borrow areas clean and neat.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavating and backfilling for footings and foundations, slabs and other concrete facilities.
 - 1. Protecting existing facilities, utilities and structures affected by excavation.
 - 2. Shoring, cribbing dewatering and related work.

1.2 RELATED SECTIONS

- A. Section 02204 - Mineral Aggregates and Fill
- B. Section 02225 - Trench Excavating and Backfilling

1.3 REFERENCES

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10 lb (4.54 Kg) Rammer and an 18 inch (457 mm) Drop
- B. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop
- C. ASTM D 1556 - Test Method for Density of Soil in Place by the Sand-Cone Method
- E. ASTM D 1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop
- F. ASTM D 2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- G. ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- H. ASTM D 3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures

1.4 PROTECTION

- A. Protect bench marks, existing structures, fences, sidewalks, paving and curbs from equipment and vehicular traffic.
- B. Protect above and below grade utilities which are to remain.
- C. Notify Contracting Officer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.
- D. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- E. Grade excavation top perimeter to prevent surface water runoff into excavation.

1.5 SUBMITTALS

- A. Submit samples in accordance with Section 01000 - Submittals.
- B. Samples and Testing: Testing shall be the responsibility of the Contractor and shall be performed by an established commercial testing laboratory subject to approval by the Contracting Officer. Quality control testing shall be performed per the Construction Control Manual. Field density and moisture content tests shall be performed in sufficient number to insure that the specified density is obtained per the Construction Control Manual. Density tests shall be performed in accordance with ASTM D 1556. Field density test results shall be provided in writing to the Contracting Officer.

1.6 DEFINITIONS

- A. Common Fill: Fill or borrow materials which are naturally occurring and not meeting a specific gradation or classification.
- B. Select Fill: Fill or borrow materials which are naturally occurring, screened or graded, or mixed to meet a specific gradation or classification.
- C. Compacted igloo cover: Fill or borrow materials which are naturally occurring, screened or graded, or mixed to meet a specific gradation or classification.

SECTION 02222
STRUCTURAL EXCAVATING AND BACKFILLING

1.7 SITE CONDITIONS

- A. Slope, shore, sheet, brace or otherwise support excavations over 4 feet deep. When soil conditions are unstable, excavations shallower than 4 feet deep must also be sloped, supported or shored.
- B. Unsuitable Weather Limitations: Do not place, spread, or roll any fill material during unsuitable weather conditions. Do not resume operations until moisture content of material is satisfactory.
- C. Weather Softened Subgrade: Remove and replace at no additional cost to Owner.
- D. Protection of Graded Areas: Protect from traffic and erosion. Keep free of trash and debris. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- E. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or unsuitable weather, scarify, reshape, and compact to required density prior to further construction.

PART 2 - PRODUCTS

2.1 MATERIALS FOR OVER EXCAVATED AREAS

- A. Select Fill: In accordance with Section 02204.
- B. Stabilization Fill: Select or Common Fill with maximum rectilinear particle size of 2 inches.
- C. Geotextile: Stabilization fabric in accordance with Section 02895.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Notify Contracting Officer prior to starting any excavation.
- B. Identify required lines, levels, contours, and datum.
- C. Identify known underground utilities. Stake and flag locations.
- D. Identify and flag surface and aerial utilities.
- E. Maintain and protect existing utilities remaining which pass through work area.
- F. Contact red stakes 14 days prior to beginning excavation.

3.2 EXCAVATION

- A. Excavate required subsoil for buildings, structures, foundations, construction operations, or similar work.
- B. If unsuitable material is encountered at the bottom of the excavation, overexcavated as directed by the Contracting Officer, and backfill.
- C. If conditions permit, slope excavation sides as excavation progresses, to maintain a safe and clean working area.
- D. Correct unauthorized excavation at no cost to the Government.
- E. Use excavated material for backfill around structures in areas designated on-site. Remove from the site any excess subsoil not reused.

3.3 PREPARATION FOR BACKFILLING

- A. Compact the top 8 inches of the subgrade surfaces to density requirements for the fill material to be placed over the subgrade.
- B. Excavate soft areas of subgrade not readily capable on in-situ compaction. Backfill with granular borrow and compact to density with granular borrow and compact to density equal to requirements for subsequent backfill material.
- C. Do not use compaction equipment adjacent to walls or retaining walls that may cause the wall to become overstressed or moved from final alignment. Do not backfill against walls until concrete has

SECTION 02222
STRUCTURAL EXCAVATING AND BACKFILLING

- obtained its 28-day design strength.
- D. Place and compact select fill materials in continuous lifts not exceeding 6 inches depth, unless specifically allowed.
 - E. Place and compact common fill material in continuous lifts not exceeding 8 inches in depth.
 - F. Employ a placement method so as not to disturb or damage foundation dampproofing, waterproofing, insulation or utilities in trenches.
 - G. Maintain optimum moisture content of fill materials to attain required compaction density.
 - H. Backfill against supported foundation walls. Backfill simultaneously on each side of unsupported foundation walls, where possible.
 - I. Slope grade away from structure at a minimum of 3 inches in 10 feet, unless otherwise noted.
 - J. Make smooth changes in grade. Blend slopes into level areas.
 - K. Use any surplus fill material on site.
 - L. Leave any allowed stockpile areas in neat, evenly graded condition, as directed by the Contracting Officer.

3.4 TOLERANCES

- A. Finished grade of backfilling shall be plus or minus one-half inch.

3.5 COMPACTION TESTING

- A. If tests indicate work does not meet specified compaction requirements, remove work, replace and retest at no cost to the Government.

3.6 REPAIR OF DAMAGED FOUNDATIONS

- A. Restore any damaged structure to its original strength or condition and re-backfill.

3.7 SCHEDULES

- A. Locations, fill material to be used, compacted thickness of each fill, and compaction expressed as a percentage of maximum density ASTM D 698 are as follows:
- B. Under Footings: Compact granular borrow in 6 inch lifts to 98 percent.
- C. Interior Slab-On-Grade: Compact granular borrow to thickness indicated in 6 inch lifts to 98 percent.
- D. Exterior side of Foundation Walls and Retaining Walls: Subsoil or select fill, each 6 inch lift compacted to 92 percent.
- E. Miscellaneous Structures: Backfill with granular borrow compacted to 96 percent.
- F. Do not backfill until concrete has reached its 28-day strength and approval to backfill has been obtained from the Engineer.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavating and backfilling for utilities from 5 feet outside buildings or other concrete facilities
- B. "Pipe zone" backfill.
- C. Trench sub-base stabilization.
- D. Removal and disposal of unsatisfactory materials.
- E. Underground plastic line markers.

1.2 RELATED SECTIONS

- A. Section 02204 - Mineral Aggregate and Fill
- B. Division 15 - Mechanical

1.3 REFERENCES

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10 lb (4.54 Kg) Rammer and an 18 inch (457 mm) Drop
- B. ASTM C 136 - Method for Sieve Analysis of Fine and Coarse Aggregates
- C. ASTM D 1556 - Test Method for Density of Soil in Place by the Sand-Cone Method
- D. ASTM D 1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop
- E. ASTM D 1267 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- F. ASTM D 2321 - Underground Installation of Flexible Thermoplastic Sewer Pipe
- G. ASTM D 2774 - Underground Installation of Thermoplastic Pressure Piping
- H. ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- I. ASTM D 3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures

1.4 DEFINITIONS

- A. Utility: Any buried pipe, conduit, or cable.
- B. Rigid Pipe: All concrete pipe, steel pipe, ductile iron pipe, clay tile pipe and asbestos-cement pipe.
- C. Flexible Pipe: All thermoplastic pipe such as PVC, PE, ABS and composites, and corrugated metal pipe.
- D. Pipe Zone: The area 4 inches under the pipe, the trench width, and 6 inches (12 inches for pipes 24 inch diameter or larger) over the pipe.
- E. Unclassified Excavation: Includes all materials encountered regardless of their nature or the manner in which they are removed.
- F. Trench Width: The outside diameter (OD) of the pipe, not including joints, plus 12 inches each side of the pipe.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01000 - Submittals.
- B. Submittals are required for all "pipe zone" materials.
- C. Samples and Testing: Testing shall be the responsibility of the Contractor and shall be performed by an established commercial testing laboratory subject to approval by the Contracting Officer. Quality control testing shall be performed per the Construction Control Manual. Field density and moisture content tests shall be performed in sufficient number to insure that the specified density is obtained per the Construction Control Manual. Density tests shall be performed in accordance with ASTM D 1556. Field density test results shall be provided in writing to the Contracting Officer.

**SECTION 02225
TRENCH EXCAVATING AND BACKFILLING**

1.6 JOB CONDITIONS

- A. Pipeline lengths indicated on drawings are for information only. Furnish pipeline lengths as required to complete the Project.
- B. Embankment Areas: Perform no work in areas receiving fill until embankment or fill has been completed to at least two feet above the top of the pipe grade, and has been properly compacted.
- C. Do not change pipe size, material, or class without securing written approval of the Contracting Officer.
- D. Unsuitable Weather Limitations: Do not place, spread, or roll any fill material during unsuitable weather conditions. Do not resume operations until moisture content of material is satisfactory.
- E. Weather Softened Subgrade: Remove and replace at no additional cost to Government.
- F. Protection of Graded Areas: Protect from traffic and erosion. Keep free of trash and debris. Repair and reestablish grades in settles, eroded, and rutted areas to specified tolerances.
- G. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or unsuitable weather, scarify surface, reshape, and compact to required density prior to further construction.

PART 2 - PRODUCTS

2.1 MATERIALS FOR OVER EXCAVATING

- A. Select Fill: In accordance with Section 02204.

2.2 "PIPE ZONE" MATERIALS

- A. Unclassified Excavation: Native materials encountered in trench excavating approved by Contracting Officer for use.
- B. Select Fill: In accordance with Section 02204.

2.3 UNDERGROUND-TYPE PLASTIC LINE MARKERS

- A. Manufacturer's standard permanent, bright-colored, continuous-printed magnetic plastic tape, intended for direct-burial service; not less than 6 inches wide by 4 mils thick.
- B. Color and message as follows:
 - 1. Green Tape: "CAUTION STORM DRAIN BURIED BELOW"
 - 2. Blue tape: "CAUTION WATER LINE BURIED BELOW"
 - 3. Orange tape: "CAUTION GAS LINE BURIED BELOW"
 - 4. Brown tape: "CAUTION SEWER LINE BURIED BELOW"
 - 5. Blue tape: "CAUTION TELEPHONE LINE BURIED BELOW"
 - 6. Rust tape: "CAUTION TELEVISION LINE BURIED BELOW"
 - 7. Red tape: "CAUTION FIRE ALARM LINE BURIED BELOW"
 - 8. Gray tape: "CAUTION 120/208 VOLT LINE BURIED BELOW"
 - 9. Sand tape: "CAUTION 347/600 VOLT LINE BURIED BELOW"
 - 10. Yellow tape: "CAUTION COMMUNICATION LINE BURIED BELOW"

2.4 LANDSCAPED AREAS

- A. Topsoil: In accordance with Section 02204.

2.5 BACKFILL CLASSIFICATIONS

- A. Class "A" Backfill.

**SECTION 02225
TRENCH EXCAVATING AND BACKFILLING**

1. Inorganic materials free from frozen materials, asphalt surfacing, or rocks larger than 6 inches in the backfill.
 2. No pockets of poorly graded particles.
 3. Native soils with a moisture content that is within 2 percentage points above optimum.
- B. Class "B" & "C" Backfill.
1. Inorganic materials free from frozen materials, asphalt surfacing, or rocks larger than 6 inches in the backfill.
 2. Finish top of the trench with salvaged site topsoil.
- C. Class "D" Backfill.
1. Inorganic materials and rocks less than 12 inches in any direction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Protect plant life and other features remaining as a portion of final landscaping.
- C. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- D. Maintain and protect above and below grade utilities which are to remain.
- E. Utilize appropriate traffic signs, markers, and procedure in all construction activities as defined in the Manual of Uniform Traffic Control Devices.
- F. Provide grading to prevent surface water from flowing into trenches or off Government Property.
- G. Store all materials minimizing inconvenience to traffic. Make provisions for urgent traffic.
- H. Provide free access to all fire hydrants, water valves and meters, and leave clearance to enable free flow of storm water in all conduits and natural water courses.
- I. Insulate dissimilar metals from direct contact with each other, using neoprene gaskets or asphalt coatings.
- J. Lay pressure lines to eliminate high points in line. Notify Contracting Officer of any unavoidable high points for possible installation of air relief valves.
- K. Lay gravity pipe upgrade, beginning at lower end.
- L. Handle pipe in accordance with accepted practices and according to manufacturer's recommendations.
- M. Do not lay pipe in water.
- N. Do not lay pipe when trench conditions or weather are unsuitable.
- O. Place circular concrete pipe which contains elliptical reinforcing so that the reference lines designating the top of the pipes will not be more than five degrees from the vertical plane through the longitudinal axis of the pipe.
- P. Use approved equipment, as recommended by the pipe manufacturer, to cut pipe.
- Q. Secure Contracting Officer's approval to deflect pipe from true line and grade. Do not exceed deflection recommended pipe manufacturer.

3.2 EXCAVATION

- A. Excavate trenches for pipes to the lines and grades called for regardless of the type of material encountered.
- B. Limit the trench width in the "pipe zone" to the defined with this Section.
- C. Backfill unauthorized overexcavation with select fill material at no expense to the Government.
- D. Hand trim excavation, removing loose matter.

3.3 SUBGRADE PREPARATION

- A. If subgrade is not readily compatible secure authorization for extra excavation and backfill with select fill.

**SECTION 02225
TRENCH EXCAVATING AND BACKFILLING**

3.4 DEWATERING

- A. Keep trenches free from water during pipe laying and joining by methods approved by the Contracting Officer.

3.5 SHORING AND BRACING

- A. Provide all shoring, bracing, or trench boxes as needed to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench in accordance with current State and Federal (OSHA) regulations.

3.6 EXISTING UTILITIES

- A. Notify redstakes prior to commencement of work.
- B. Accept responsibility for repair of utilities damaged during construction whether shown on the Drawings or not. Damaged utilities are not to be covered until repairs are verified by utility and Contracting Officer.

3.7 "PIPE ZONE" CONSTRUCTION

- A. General.
 - 1. Backfill trench after installation has been approved by Contracting Officer.
 - 2. Trench backfill in the "pipe zone" is termed bedding.
 - 3. Changes in bedding can only occur with written approval by Contracting Officer.
 - 4. Protect pipe during bedding.
 - 5. Allowable pipe deflections limits from manufacturers will be enforced.
 - 6. Round bottom of "pipe zone" so that at least the bottom quadrant of the pipe rests firmly on compacted bedding for the entire length of barrel.
 - 7. Place bedding material evenly on each side of pipe in lifts not exceeding compacted 6 inches, compact to at least 85 percent of the laboratory density as determined by ASTM D 698. Continue to top of "pipe zone".
- B. Bedding materials.
 - 1. Use native materials in the "pipe zone" consisting of sands, silts, and gravels with oversized rock removed.
 - 2. When excavated native material is not suitable for bedding, provide select fill materials according to Section 02204 and the following size limitations:
 - Rigid pipe materials.
 - a) Ductile Iron Pipe and steel cylinder pipes (non-tape wrapped) and concrete pipe: Rocks no larger than 1-1/2 inch diameter, or larger than the pipe wall thickness, whichever is greater. Select fill materials specified in Section 02204 are acceptable, however same size limits apply.
 - b) Tape wrapped steel cylinder pipe and asbestos concrete pipe: Rocks no larger than 3/4 inch diameter, or larger than the pipe wall thickness, whichever is greater. Select fill material specified in Section 02204 are acceptable, however same size limits apply.
 - c) Slotted or perforated pipe: Use select fill sewer rock gradation.
 - d) Install Ductile Iron Pipe according to AWWA C600 types.
 - Flexible Pipe Materials.
 - e) Plastic pipes: Rocks no larger than 3/4 inch diameter. Select fill materials specified in Section 02204 are acceptable, however same size limits apply.
 - f) Corrugated metal pipe: Rocks no larger than 1-1/2 inch diameter. Select fill materials specified in Section 02204 are acceptable, however same size limits apply.

3.8 BACKFILL

**SECTION 02225
TRENCH EXCAVATING AND BACKFILLING**

- A. Class "A" Backfill.
 - 1. All trenches under roadways, driveways, and other paved areas, or when required.
 - 2. Backfill the trench above the "pipe zone" with approved excavated trench materials. Place in 6 inch layers and compact by means of mechanical tampers or vibratory compactors to a minimum of 96 percent average with nothing less than 92 percent of maximum dry density per ASTM D1556.
- B. Class "B" Backfill.
 - 1. All trenches utilizing Class "B" backfill procedures, when required, according to one of the alternative methods.
 - 2. Mechanically Compacted Alternative.
 - a) Backfill the trench above the "pipe zone" with approved excavated trench materials. Place in layers not more than 12 inches thick, compacting each layer by means of mechanical tampers or vibratory compactors to a minimum of 92 percent average with nothing less than 90 percent of maximum dry density per ASTM D1556.
 - 3. Water Settling Alternative.
 - a) Consolidate the backfill by water settling using the following procedure if the backfill material is granular and specifically allowed by the Contracting Officer.
 - 1) Place suitable backfill material in the trench in lifts of not more than 4 foot depth. After each lift, place water in the trench backfill by flooding or pressure jetting so that the lift become completely saturated, with free standing water 1 inch deep (minimum) over surface.
 - 2) Mechanically compact the top 24 inches of the trench backfill to a minimum of 90 percent of maximum dry density.
 - 3) Provide the quantity of water required for water settling.
 - b) Contracting Officer's permission to use such methods in consolidating backfill does not relieve the Contractor of responsibility to repair subsequent settlement within the warranty period, nor relieve the Contractor of any damage or flooding.
- C. Class "C" Backfill.
 - 1. Backfill all trenches in landscaped or farmed areas, or when required.
 - 2. Backfill the trench above the "pipe zone" with approved trench materials. Place in 12 inch layers and compact by means of mechanical tampers or vibratory compactors to a minimum of 90 percent average with nothing less than 88 percent of maximum dry density.
- D. Class "D" Backfill.
 - 1. Backfill all trenches as required.
 - 2. Backfill entire trench with suitable material to a point above the existing ground surface or the finish grade.
 - 3. Compact by wheel rolling as backfilling proceeds, and leave mounded for settlement. Rake or blade to match the ground surface adjacent to the trench after completion of compaction.
 - 4. Maintain the surface of the backfilled trench level with the existing grade by additions of topsoil, as directed, until final surface replacement is completed, or the entire project is accepted.

3.9 RESTORATION OF LANDSCAPED AREAS

- A. Replace fences or other items removed from within the landscaped areas to preconstruction conditions and remove rocks, dirt, or any debris that remain from the construction.

END OF SECTION

PART1 - GENERAL

1.1 SECTION INCLUDES

- A. Material requirements for asphalt cement, emulsified asphalt cement.
- B. Material requirements for latex additive and anti-strip additive.
- C. This is a materials specification for asphalt vendors.

1.2 RELATED SECTIONS

- A. Section 02504 - Asphalt Concrete
- B. Section 02505 - Asphalt Mixture Quality Control
- C. Section 02510 - Plant Mix Asphalt Concrete Paving

1.3 REFERENCES

- A. AASHTO T 102: Standard Method of Spot Test of Asphaltic Materials
- B. ASTM D 5: Standard Test Method for Penetration of Bituminous Materials
- C. ASTM D 92: Standard Test Method for Flash and Fire Points by Cleveland Open Cup
- D. ASTM D 95: Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation
- E. ASTM D 113: Standard Test Method for Ductility of Bituminous Materials
- F. ASTM D 140: Standard Methods of Sampling Bituminous Materials
- G. ASTM D 243: Standard Test Method for Residue of Specified Penetration
- H. ASTM D 244: Standard Methods of Testing Emulsified Asphalt
- I. ASTM D 402: Standard Test Method for Distillation of Cut-Back Asphaltic (Bituminous) Products
- J. ASTM D 1298: Standard Test Method for Density, Relative density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- K. ASTM D 2007: Standard Test Method for Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum Derived Oils by the Clay-Gel Absorption Chromatographic Method
- L. ASTM D 2042: Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene
- M. ASTM D 2170: Standard Test Method for the Kinematic Viscosity of Asphalts (Bitumens)
- N. ASTM D 2171: Standard Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer
- O. ASTM D 2872: Standard Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)
- P. ASTM D 3142: Standard Test Method for Flash Point of Cutback Asphalt with Tag Open-Cup Apparatus
- Q. ASTM E 70: Standard Test Method for pH of Aqueous Solutions with the Glass Electrode

1.4 SUBMITTALS

- A. Bill of lading for each shipment of Paving Asphalt from Vendor:
Certify the Following:
 - 1. Type and grade of asphalt delivered
 - 2. Whether additives have been used and, if so, the type and amount
 - 3. Destination
 - 4. Consignee's name
 - 5. Date of shipment
 - 6. Railroad car or truck identification
 - 7. Loading temperature
 - 8. Net weight (or net gallons corrected to 60 degrees F., when requested)
 - 9. Specific gravity
 - 10. Bill of lading material
 - 11. Source of bituminous material (manufacturer)
- 12. Laboratory control test reports for material properties enumerated herein.

**SECTION 02503
PETROLEUM ASPHALTS FOR PAVING**

1.5 QUALITY ASSURANCE

- A. The paving asphalts shall be sampled in accordance with ASTM D 140, and the properties enumerated in this section shall be determined by the vendor on accordance with indicated ASTM methods. Reject bituminous materials which fail to meet indicated requirements.
- B. Each shipment of petroleum asphalt for paving shall be uniform in appearance and consistency.
- C. Do not use storage containers contaminated with other types or grades of asphalt.
- D. Emulsion samples shall be stored in clean, air tight sealed containers.

PART 2 - PRODUCTS

2.1 ASPHALT CEMENT (AC)

- A. A steam refined asphalt produced from crude asphaltic petroleum, homogeneous, free from water, and does not foam when heated to 347 degrees F. (175 degrees C.)(See table No. 02503-1).

TABLE NO. 02503-1

PROPERTY AND TEST SPECIFICATION	TYPE AND GRADE	
	AC-10	
	Min	Max
Viscosity, 140°F (60°C), P., ASTM D 21271	800	1200
Viscosity, 275°F (135°C), St., ASTM D 21270	1.9	-
Penetration, 77°F (25°C), 100g, μm, 5 sec., ASTM D 5	80	-
Flash Point (Cleveland Open Cup), °F(°C), ASTM D 92	425 (219)	-
Solubility in trichloro-ethylene, %, ASTM D 2042	99.0	-
Ductility, 32.9°F (4°C) 1 cm/min, cm., ASTM D 113	15	-
Spot Test, AASHTO T 102	Negative	

2.2 EMULSIFIED ASPHALT

- A. An asphalt cement uniformly emulsified with water, homogenous throughout and, when stored shows no separation within 30 days after delivery (See Table 02503-2).

TABLE NO. 02503-2

REQUIREMENTS FOR ATONIC EMULSIFIED ASPHALT		
PROPERTY AND TEST SPECIFICATION	TYPE AND GRADE	
	RAPID SETTING	
	RS-1	RS-2
Test on emulsions: The following tested by ASTM D 244		
Viscosity, Saybolt Furaol at 77°F(25°C), sec	20 - 100	-
Viscosity, Saybolt Furaol at 122°F (50°C), sec	-	75 - 400
Settlement, 5 days, %, max	5	5
Storage Stability test, 1 day, max	1	1
Demulsibility, (5ml. 0.02 N CaCl ₂), %, min.	60	60
Sieve Test (retained on No. 20), %, max.	0.01	0.01
Cement Mixing Test, %, max.	-	-
Residue by Distillation, %, min	55	63
Tests on Distillation Residue ASTM tests as indicated.		
Penetration, 77°F (25°C) 100g, 5g, μm., ASTM D 5	100 - 200	100 - 200
Ductility 77°F (25°C), 5/cm/min, cm. min. ASTM D 113	40	40
Solubility in trichloroethylene, %, min. ASTM D 2042	97.5	97.5

2.3 GUIDELINE TEMPERATURES FOR STORAGE AND HANDLING ASPHALTS

A. Warning:

1. Heating of asphaltic materials (except emulsions) constitutes a fire hazard to various degrees. Proper precautions should be used in all cases.
2. Storage temperatures in the 212-265 degrees F. (100-130 degrees C.) range are particularly troublesome. Storage temperatures should be either below 212 degrees F. (100 degrees C.) or above 265 degrees F. (130 degrees C.). Do not cycle temperatures above and below the boiling point of water.

B. Asphalt Cement and Cut-back Asphalt: Do not reheat asphalts during manufacture or storage to cause deformation of carbonized particles. Table No. 02503-5 contains guideline storage temperatures for various types and grades of asphalt. The guideline is not rigid, but is intended to indicate temperatures for good storage practice, pumpability, and environmental conditions. The values reported by the flash point test are specific to the test procedures employed and are not necessarily representative of the vapor space atmospheres existent in storage.

**SECTION 02503
PETROLEUM ASPHALTS FOR PAVING**

TABLE No. 02503-5		
ASPHALT CEMENT AND CUT-BACK ASPHALT STORAGE AND HANDLING TEMPERATURE GUIDELINE		
TYPE AND GRADE	MIN FLASH °F (°C)	STORAGE TEMP °F(°C)
AC-5	350 (177)	330 (166)
AC-10	400 (219)	345 (174)
AC-20	450 (232)	350 (177)
AC-70	150 (66)	150 (71)
AC-250	175 (79)	195 (91)
AC-800	200 (93)	210 (99)
AC-3000	225 (107)	210 (99)

- C. Anionic and Cationic Emulsion Asphalt Temperatures: At no time after loading for transportation from refinery to the purchaser shall the temperature of the emulsion be raised above 180 degrees F. (82 degrees C.). During reheating, the emulsified asphalt shall be agitated to prevent localized overheating. Emulsified asphalt shall not be permitted to cool to a temperature of less than 40 degrees F. (4.5 degrees C.).

TABLE No. 02503-6				
MIXING AND APPLICATION TEMPERATURE FOR EMULSIFIED ASPHALT				
Grade of Emulsified Asphalt	Mixing Temperatures Pug Mill, °F		Application Temperature, °F	
	Minimum	Maximum	Minimum	Maximum
RS-1, CRS-1	-	-	75	130
RS-2, CRS-2	-	-	110	160

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prime coat; Section 02508.
B. Plant mix asphalt concrete paving; Section 02510.

END OF SECTION

**SECTION 02503
PETROLEUM ASPHALTS FOR PAVING**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Plant-mix paving material requirements.
- B. Mix design requirements.

1.2 RELATED SECTIONS

- A. Section 02503 - Petroleum Asphalt for Paving
- B. Section 02505 - Asphalt Mixture Quality Control
- C. Section 02510 - Plant Mix Asphalt Concrete Paving

1.3 REFERENCES

- A. ASTM C 136: Standard Method for Sieve Analysis of Fine and Coarse Aggregates
- B. ASTM D 242: Standard Specification for Mineral Filler for Bituminous Paving Mixtures
- C. ASTM D 1075: Standard Test Method for Effect of Water on Cohesion of Compacted Bituminous Mixtures
- D. ASTM D 1559: Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
- E. ASTM D 1664: Standard Test Method for Coating and Stripping of Bitumen-Aggregate Mixtures
- F. ASTM D 2041: Standard Test Method for Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
- G. ASTM D 3203: Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
- H. ASTM D 3515: Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
- I. ASTM D 4215: Standard Specification for Cold-Mixed, Cold-Laid Bituminous Paving Mixture

1.4 DEFINITIONS

- A. Asphalt-Aggregate Designator: An alpha-numeric code which indicates the type and grade of asphalt, and the type and grade of aggregate in an asphalt-aggregate mix.
 - 1. For example, "AC-20-DM-3/4" means the asphalt-aggregate mix shall be composed of an AC-20 type and grade of asphalt cement and a DM-3/4 type and grade of aggregate.
 - 2. "RA-1-DM-1" means the asphalt-aggregate mix shall be composed of an RA-1 type and grade of rejuvenating asphalt and a DM-1 type and grade of aggregate.

1.5 SUBMITTALS

- A. Asphalt Concrete Mix design: Indicate ideal aggregate gradation; optimum stability, flow, and percent air voids; unconfined compression strength index; percent retention of bituminous film on aggregate surface in presence of water; bulk density; optimum asphalt content; asphalt to dust ratio; and additives or if none, state none are required.
- B. Source Aggregate Sample Report: Indicate rodded weight of aggregate, percentage of warm weight loss, sand equivalent value, percent of fractured faces, amount of organic matter, plasticity of fines, and percentage of fines retained in the aggregate.
- C. Pre-Approved Mix Design Data: If supplier has on record, an Contracting Officer approved mix design, submit name and address of supplier for each mix design one day prior to using asphalt concrete mix.

1.6 QUALITY ASSURANCE

- A. Bitumen weights shall be determined by the mix design.
- B. Use asphalt cement when recycled asphalt mixtures are indicated.
- C. Do not change source of supply of paving asphalt or aggregate without Contracting Officer's written

**SECTION 02504
ASPHALT CEMENT**

- approval.
- D. Each shipment of bituminous material shall be uniform in appearance and consistency with no foaming when heated to the specified mixing temperature.
- E. Do not use storage containers contaminated with other asphalt types or grades.
- F. Reject all asphalt concrete mixes which exceed 325 degrees F. at the plant except latex modified asphalt concrete and then not to exceed engineering design temperature.

PART 2 - PRODUCTS

2.1 PAVING ASPHALT

- A. Provide type and grade indicated. If not indicated, then select as follows:
 - 1. Plant-mix or road-mix: AC-10 asphalt cement which complies with Section 02503.
- B. Based upon the optimum asphalt content and the number of test samples in a lot, the allowable percent variance of asphalt content in the mixture is as follows.

TABLE No. 02504-1

MAXIMUM ALLOWABLE VARIANCE FROM OPTIMUM ASPHALT CONTENT					
TEST METHOD	1 Test	2 Tests	3 Tests	4 Tests	5 Tests or More
ASTM D 1272 (Method E)	0.70	0.54	0.46	0.41	0.38

2.2 ADDITIVES

- A. In accordance with mix design and Section 02503.

2.3 AGGREGATES

- A. Clean, hard, tough, durable and sound mineral aggregates that consist of crushed stone, crushed gravel, or crushed slag conforming to the following requirements.
 - 1. Dry Unit Weight: Not less than 75 pounds per cubic foot.
 - 2. Hardness: Percentage of wear of coarse aggregate retained on the No. 8 sieve; less than 40 unless specific aggregates having higher values are known to be satisfactory.
 - 3. Soundness: Weight loss; less than 16 percent by weight when subjected to 5 cycles of sodium sulfate.
 - 4. Sand Equivalent Value of Combined Aggregate After Going Through Dryer: Not less than 45 percent.
- B. Coarse Aggregate: Portion retained on the No. 4 sieve has not less than 50 percent of particles by weight with at least two mechanically fractured faces or clean angular faces.
- C. Fine Aggregate:
 - 1. Fine aggregate passing the No. 4 sieve may be either a natural or manufactured product containing not more than 2 percent by weight of organic matter or other deleterious substances.
 - 2. Aggregate passing the No. 40 sieve is nonplastic.
- D. Mineral Filler: When mix design indicates need, add as a separate ingredient; ASTM D 242.
- E. Master Grading Band Limits: In accordance with Table No. 02504-2.
- F. Target Grading Band Limits: In accordance with Table No. 02504-3.

TABLE No. 02504-2

MASTER GRADING BAND LIMITS

SIEVE SIZE	DENSE MIXTURES*	OPEN MIXTURES*		FRICTION MIXTURES*	
	Grade DM-1	Grade OM-1	Grade OM-2	Grade FM-1	Grade FM-2
1"	100 --				
¾"	-- --			100 --	
½"	75-91	100 --	100 --	90-100	100 --
"	-- --	95-99	95-99	60-100	90-100
#4	46-62	36-40	36-40	15-40	30-50
#8	-- --	14-20	27-30	4-12	5-15
#16	21-35	10-14	18-24	-- --	-- --
#50	12-22	6-10	11-15	-- --	-- --
#200	3 - 7	2 - 4	3 - 5	2 - 5	2 - 5

* Based on fine and coarse aggregate having approximately the same bulk specific gravities.

TABLE No. 02504-3

TARGET GRADING BAND LIMITS					
SIEVE SIZE	MEAN OF THE DEVIATIONS OF SIEVE GRADATION RESULTS FROM THE COMBINED AGGREGATE TARGET Expressed in Percentage Points				
	1 Test	2 Tests	3 Tests	4 Tests	5 Tests
½ inch	± 10	± 7.3	± 6.3	± 5.6	± 5.2
_ inch	± 9	± 6.9	± 5.9	± 5.3	± 4.9
No. 4	± 9	± 6.7	± 5.7	± 5.2	± 4.8
No. 8	± 7	± 5.6	± 4.8	± 4.3	± 4.0
No. 16	± 7	± 5.2	± 4.6	± 4.2	± 3.9
No. 50	± 6	± 4.3	± 3.8	± 3.4	± 3.2
No. 200	± 3	± 2.4	± 2.0	± 1.8	± 1.7

2.4 ASPHALT CONCRETE MIX DESIGN

- A. Optimum Stability, Flow and Air Voids: Determine in accordance with ASTM D 1559 (Marshall mix design method), establish criteria for laboratory target specimen based upon the traffic classifications, and the allowable limits in Table No. 02504-5.

TABLE No. 02504-5

ALLOWABLE LIMITS FOR STABILITY, FLOW AND AIR VOIDS	
ASPHALT CONCRETE PROPERTIES	TRAFFIC CLASSIFICATIONS
	CLASS II & III
Number of Compaction blows each end of specimen	50

**SECTION 02504
ASPHALT CEMENT**

Stability, lbs.	1500
Flow, in 0.01 in. units	8 - 18
% Air Voids, Surfacing and Leveling Base	3 - 5 3 - 8

- B. Unconfined Compression Strength Retention Index: 65 minimum in accordance with ASTM D 1075.
- C. Retention of Asphalt Film on Aggregate in the Presence of Water: Greater than 95 percent in accordance with ASTM D 1664.
- D. Bulk Density Target: Determined in accordance with ASTM D 3203.
- E. Asphalt Content Target: Determined from optimum percentage of asphalt in laboratory target specimen.
- F. Additives: As necessary and in accordance with Section 02503 to prevent stripping of asphalt from aggregate or to bring asphalt concrete strength into compliance.
- G. Asphalt to Dust Ratio: Not more than 1.0 to 1.2.

2.5 MIXING PLANT

- A. Hot-mixed, hot-laid paving mixtures; ASTM D 3515.

2.6 SOURCE QUALITY CONTROL

- A. Verify aggregate grading compliance in accordance with ASTM D 136. Sieve gradations are based upon percent of aggregate passing sieves by weight. Samples selected uniformly on time on a random basis.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Plant Mix Asphalt Concrete Paving; Section 02510.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Contractor's responsibility for quality control in providing bituminous paving mixtures.

1.2 REFERENCES

- A. AASHTO T 230: Standard Method of Test for Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures
- B. ASTM C 29: Standard Test Method for Unit Weight and Voids in Aggregate
- C. ASTM C 88: Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
- D. ASTM C 131: Standard Test Method for Resistance to Degradation of Small-Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine
- E. ASTM C 136: Standard Method for Sieve Analysis of Fine and Course Aggregates
- F. ASTM D 75: Standard Practice for Sampling Aggregates
- G. ASTM D 113: Standard Test Method for Ductility of Bituminous Materials
- H. ASTM D 140: Standard Methods of Sampling Bituminous Materials
- I. ASTM D 546: Standard Methods for Sieve Analysis of Mineral Filler for Road and Paving Materials
- J. ASTM D 979: Standard Methods for Sampling Bituminous Paving Mixtures
- K. ASTM D 1140: Standard Test Method for Amount of Material in Soils Finer Than the No 200 (75- Φ m) Sieve
- L. ASTM D 1164: Standard Test Method for Coating and Stripping of Bitumen-Aggregate Mixtures
- M. ASTM D 2170: Standard Test Method for Kinematic Viscosity of Asphalts (Bitumens)
- N. ASTM D 2172: Standard Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
- O. ASTM D 2419: Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregates
- P. ASTM D 2950: Standard Test Method for Density of Bituminous Concrete In Place by Nuclear Method
- Q. ASTM D 23203: Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
- R. ASTM D 3549: Standard Test Method for Thickness of Height of Compacted Bituminous Paving Mixture Specimens
- S. ASTM D 4318: Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- T. UDOT Test Procedure 8-929: Determination of Rounded Particles of Course Aggregates

1.3 DEFINITIONS

- A. Lot: The area or quantity of bituminous mix paving containing one or more sublots. Each subplot consists of a specified area, volume, or weight which is used for testing and acceptance purposes.

1.4 SUBMITTALS

- A. Field and laboratory control test reports for material properties enumerated herein.

1.5 ACCEPTANCE

- A. Acceptance of products and materials shall be based upon the following lot sizes.
 - 1. Bitumens Prior to Mixing: The Lot size shall be one subplot of 10,000 gallons or portion thereof plus any additional subplot of 10,000 gallons or portion thereof of each bitumen placed in any one week.
 - 2. Aggregates Prior to Mixing: Each aggregate source.
 - 3. Composition of Bituminous Mix Prior to Compaction: The Lot size shall be one subplot of 500 tons plus any additional 500 ton subplot or portion thereof of each bituminous mix placed in any one week.
 - 4. Pavement Density: The size shall be one subplot of 1,600 square yards plus any additional 1,600 square yards subplot or portion thereof of each bituminous mix placed in any one day.

**SECTION 02505
 ASPHALT MIXTURE QUALITY CONTROL**

- 5. Pavement Thickness: The Lot size shall be 1,600 square yards of finished product.
- 6. Pavement Smoothness: The Lot size shall be each random tests selected by Contracting Officer.

1.6 JOB CONDITIONS

- A. Furnish labor to assist in obtaining and handling samples at site or sources.
- B. As a result of failed tests, perform remedial work at no additional cost to the Government.

PART 2 - PRODUCTS - Not used

PART 3 - EXECUTION

3.1 TESTING BITUMENS PRIOR TO MIXING

- A. Secure test samples of each type and grade of bitumen in accordance with ASTM D 140.
- B. Test each sample for ductility in accordance with ASTM D 113, except ductility at 77 degrees F. (25 degrees C.) shall be replaced with ductility at 39.2 at 39.2 degrees F. (4 degrees C.) with values listed in Table No. 02503-3.1. The loss on heating requirement on residue from "Thin-Film Oven Test" shall be deleted.

TABLE No. 02503-3.1

BITUMEN DURABILITY @ 39.2 DEGREES F.	
TYPE AND GRADE	DUCTILITY, 1cm/min, cm
AC-10	15+

- C. Test each sample for kinematic viscosity in accordance with ASTM D 2170.

3.2 TESTING AGGREGATE PRIOR TO MIXING

- A. Sample each aggregate source in accordance with ASTM D 75 prior to start of paving operation or each change of aggregate source.
- B. Test each sample for the following:
 - 1. Cleanliness; ASTM D 2419.
 - 2. Percent of rounded particles; UDOT Test Procedure 8-929.
 - 3. Fines nonplasticity; ASTM D 4318.
 - 4. Percentage of fines in aggregate; ASTM C 136.
 - 5. Unit weight of aggregate; ASTM C 29.
 - 6. Percentage of wear; ASTM C 131.
 - 7. Soundness of aggregate; ASTM C 88.
 - 8. Percentage of fines passing No. 200 sieve; ASTM D 1140

3.3 TESTING COMPOSITION OF BITUMINOUS MIX PRIOR TO COMPACTION

- A. Secure test samples from the laydown operation in accordance with ASTM D 979.
- B. Test each sample for the following:
 - 1. Aggregate gradation, in accordance with ASTM C 136 to the No. 30 sieve and ASTM D 546 for smaller particles.
 - 2. Bitumen content, in accordance with ASTM D 2172, Method E.

SECTION 02505
ASPHALT MIXTURE QUALITY CONTROL

3. Stripping of bitumen-aggregate mixtures (retention of bituminous film on an aggregate surface in the presence of water) in accordance with ASTM D 1664.

3.4 TESTING PAVEMENT DENSITY

- A. Test each sample in-place in accordance with ASTM D 2950 nuclear density method, or AASHTO T 230, when slabs or cores are taken for laboratory testing.
- B. In case of dispute, AASHTO T 230 and ASTM D 3203 shall be used.

3.5 TESTING PAVEMENT THICKNESS

- A. If a nuclear device is used to determine the pavement density, the thickness may be computed with the following equation:

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Liquid asphalt on untreated base coarse prior to placing a bituminous mix or Portland cement concrete base or surface coarse.
- B. Placing sand on areas which are overprimed.

1.2 RELATED SECTION

- A. Section 02204 - Mineral Aggregate and Fill
- B. Section 02503 - Petroleum Asphalt for Paving
- C. Section 02505 - Asphalt Mixture Quality Control

1.3 SUBMITTALS

- A. Material certificates from paving asphalt vendor showing asphaltic material complies with standards required on Section 02503.

1.4 WEATHER LIMITATIONS

- A. Apply prime coat only when air and roadbed temperatures in the shade are greater than 40 degrees F. The temperature restrictions may be waived only upon written authorization for Contracting Officer.
- B. Do not apply prime coat during rain, fog, dust, or other unsuitable weather.

PART 2 - PRODUCTS

2.1 ASPHALT MATERIAL

- A. Rapid Cure Cutback Asphalt: Grade RC-1, RC-2, or RC-250

2.2 SAND

- A. Common Sand Fill, in accordance with Section 02204

PART 3 - EXECUTION

3.1 PREPARATION

- A. If aggregate base course to be primed contains an appreciable amount of loose material or is excessively dusty; moisten, blade, roll, and recompact to make the surface dense.
- B. Do not start priming until all free surface moisture has disappeared.
- C. Notify Contracting Officer 24 hours prior to applying prime coat.
- D. Provide pedestrian access across prime coat if required.

3.2 APPLICATION

- A. When pavement surface under pavement overlay is loosely bonded, apply prime coat at 0.10 to 0.50 gallons per square yard to penetrate and seal but not flood surface.
- B. Cure and dry as long as necessary to attain penetration and evaporation of volatile.
- C. Blot overprimed surface by spreading a light, uniform layer of sand.
- D. Prime underprimed areas with additional asphalt.

**SECTION 02508
PRIME COAT**

3.3 PROTECTION

- A. Protect all structures, including curb and gutter, sidewalks, guardrail and guide posts from being spattered or marred, by covering with building paper or other suitable materials. Remove any spattering or marring at no additional cost to the Government.
- B. Do not discharge bituminous material into borrow pits or gutters.
- C. Prevent tracking of prime coat onto adjacent surfaces.

3.4 OPENING TO TRAFFIC AND MAINTENANCE

- A. Do not permit traffic to travel over freshly primed surface until prime coat has cured. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road. If one-way traffic is provided, control traffic by flagging or pilot car operation.
- B. After prime coat application, leave work area undisturbed. If prime coat is tacky or tends to pick up under traffic after four hours, blot excess prime coat with blotter sand. Prime coats can be opened to traffic after blotting.
- C. Clean and maintain primed surfaces until surface pavement course is placed. Maintenance includes spreading any necessary additional blotter material, replacing all portions of prime coat that have been destroyed, and patching any break in primed surfaces.

END OF SECTION

PART 1 - GENERAL

1.1 **SECTION INCLUDES**

- A. Emulsified asphalt on existing asphalt concrete or Portland cement concrete surfaces preparatory to placing an asphalt concrete pavement.
- B. Brooming, washing or other cleaning of area to receive the bituminous coat.

1.2 **RELATED SECTIONS**

- A. Section 02503 - Petroleum Asphalt for Paving
- B. Section 02505 - Asphalt Mixture Quality Control

1.3 **SUBMITTALS**

- A. Material certificates from paving asphalt vendor showing asphaltic material complies with standards required in Section 02503.

1.4 **WEATHER LIMITATIONS**

- A. Apply tack coat only when air and roadbed temperatures in the shade are greater than 40° F. The temperature restrictions may be waived only upon written authorization from Contracting Officer.
- B. Do not apply tack coat during rain, fog, dust, or other unsuitable weather.

PART 2 - PRODUCTS

2.1 **ASPHALT MATERIAL**

- A. Anionic Emulsified Asphalt: Grade SS-1 or SS-1h in accordance with Section 02503 and diluted 1 part water to 1 part emulsified asphalt.
- B. Cationic Emulsified Asphalt: Grade CSS-1 or CSS-1h in accordance with Section 02503 and diluted 1 part water to 1 part emulsified asphalt.

PART 3 - EXECUTION

3.1 **PREPARATION**

- A. Prior to applying the tack coat, clean the surface to be treated free of dust or other foreign material. If flushed, allow surface to dry.
- B. Prevent pedestrians, vehicles, pets, etc., from tracking tack coat onto adjacent surfaces.

3.2 **APPLICATION**

- A. Tacking Existing Portland Cement or Asphalt Concrete Surfaces: Spray diluted emulsion at rate of 0.05 to 0.15 gallons per square yard.
- B. Tacking for Paving Fabric: Spray dilute emulsion at following rates.
 - 1. Dry pavement surface; 0.20 to 0.30 gallons per square yard. Within street intersections, on step grades, and in zone where vehicle speed changes are commonplace the application rate shall be reduced to no less than 0.20 gallons per square yard.
 - 2. Heavy duty fabrics; 0.30 to 0.40 gallons per square yard.
- C. Apply tack coats to area of pavement which can be covered with bituminous mixture in the same day.

**SECTION 02509
TACK COAT**

3.3 PROTECTION

- A. Protect all structures, including curb and gutter, sidewalks, guardrails and guide posts from being spattered or marred, by covering with building paper or other suitable materials. Remove any spattering or marring at no additional cost to Owner.
- B. Do not discharge bituminous material into borrow pits or gutters.

3.4 OPENING TO TRAFFIC AND MAINTENANCE

- A. Do not permit traffic to travel over the tracked surface until bituminous tack coat has cured or is not picked up by traffic. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road. If one-way traffic is provided, control traffic by flagging or pilot car operation.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hot-Mixed, hot-laid bituminous paving operations for base, leveling, and surface courses.

1.2 RELATED SECTIONS

- A. Section 02503 - Petroleum Asphalts For Paving
- B. Section 02504 - Asphalt Concrete
- C. Section 02505 - Asphalt Mixture Quality Control

1.3 SUBMITTALS

- A. Submittals of Section 02504 applicable to work of this section include:
 - 1. Mix design for paving application.
 - 2. Asphalt and aggregate material source report.
 - 3. Name of Supplier.
- B. Asphalt Concrete. Include the following information:
 - 1. Type and grade of asphalt cement.
 - 2. Type and grade of aggregate.
 - 3. Applicable mix design method.
 - 4. Separate weights of aggregate and asphalt.
- C. Machine manufacturer's data for compaction effort required for compacting asphalt concrete to specified compaction tolerances.
- D. Control testing results for density, thickness, smoothness, and asphalt concrete material requirements, verifying compliance with specified standards; Section 02505.

1.4 WEATHER LIMITATIONS

- A. Pave only when air and roadbed temperatures in the shade are greater than 35 degrees F. The temperature restrictions may be waived only upon written authorization from Contracting Officer.
- B. Do not pave during rain or unsuitable weather.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Asphalt Concrete Mix: In accordance with Section 02504. Unless indicated otherwise use asphalt cement as the bituminous binder and the type and grade of aggregate indicated or accepted by Engineer.
- B. Prime Coat: In accordance with Section 02508 - Prime Coat.
- C. Tack Coat: In accordance with Section 02509 - Tack Coat.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify base course aggregate is placed to grade and compacted as indicated in Section 02225.
- B. Herbicide treatment required if weed control prior to paving is indicated.
- C. If indicated, apply prime coat to base course surface in accordance with Section 02508.
- D. Apply tack coat in accordance with Section 02509.
- E. Remove excess soil, sand, base course and objectionable materials prior to placing the paving course.

**SECTION 02510
PLANT MIX ASPHALT CONCRETE PAVING**

- F. Repair holes and depressions in existing pavements by removing all loose and effective material and replacing with an approved asphalt-aggregate patching material. Compact to produce a dense surface.
- G. Stabilize rocking Portland cement concrete subgrade slabs. When stabilized, clean, tack, and cover concrete with a leveling course of the asphalt mixture to be used for the overlay.
- H. Remove excess asphalt in patches and joints.

3.2 TRAFFIC CONTROL

- A. Refer to Construction facilities requirements.
- B. Direct traffic through work with traffic control devices to provide worker and public safety.
- C. Erect barricades to protect paving from traffic until mixture has cooled enough to not become marked.

3.3 TEMPORARY SURFACING

- A. Place, roll, maintain, remove and dispose of temporary surfaces.
- B. Place temporary pavements as soon as the condition of the backfill is suitable and leave in place until ready for permanent surfacing.

3.4 PLACING PAVEMENT MIXTURE

- A. Remove excess sand or paving asphalt before beginning paving operation.
- B. Spread mixture to the line, grade, elevations, thickness and typical section, indicated or designated.
- C. Mat thickness: Place in total compacted thickness which does not exceed pneumatic or vibrator equipment limits and which is not less than 2 times the maximum particle size.
- D. Minimum Laydown Temperature: In accordance with Table No. 02510-1.

TABLE No. 02510-1

MINIMUM LAYDOWN TEMPERATURE, Degrees F.*						
AMBIENT AIR TEMPERATURE	COMPACTED PAVING MAT THICKNESS					
	3/4"	1"	1-1/2"	2"	3"	4"+
50-59	-	-	-	280	270	255
60-69	-	-	285	275	265	250
70-79	285	285	280	270	265	250
80-89	280	275	270	265	260	250
90+	275	270	265	260	250	250

*295 degrees for mixes containing rubberizing agent.

- E. Uninterrupted Paving: Adjust production of mixing plant and paving material delivery to obtain a continuous uninterrupted forward paving operation.
- F. Irregular Areas: Use grader, spreader box or other approved method of spreading for irregular areas; for miscellaneous construction such as detours and sidewalks; and for leveling courses.

3.5 JOINTS

**SECTION 02510
PLANT MIX ASPHALT CONCRETE PAVING**

- A. Make joints between old and new pavements, or between successive day's work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of bituminous pavement course. clean contact surfaces and apply tack coat.
- B. Offset longitudinal joints a minimum of 12 inches in succeeding courses and at least 6 feet transversely to avoid a vertical joint through more than one course. In the top course restrict longitudinal joint to 1 foot either side of lane lines.
- C. Prevent traffic, including construction traffic, from crossing vertical edges. Apply tack coat to vertical edges prior to making another pass with the paver if the mix has cooled to 90 degrees F.

3.6 ROLLING AND COMPACTION

- A. After the mixture has been spread, provide the number, type and weight of the rollers sufficient to compact the mixture without detrimentally affecting the materials finish and compaction.
- B. Roll roadway surfaces longitudinally, beginning at the outside edge or lower side and proceeding toward the higher side. Overlap each pass roller over the preceding pass enough to assure not disturbing any of the previously rolled material.
- C. Do not allow rollers to pass over unprotected ends of freshly placed mix. At bridge ends or at ends of other rigid-type structures, compact transversely as well as longitudinally.
- D. Complete compaction with steel wheel before mixture temperature drops below 180 degrees F. or 295 degrees F. for mixes containing rubberizing agent.
- E. Compact paving mixtures to an average of 96 percent of the optimum density with no density determination less than 92 percent.
- F. To establish rolling pattern for obtaining densities, provide test strips no shorter than 300 feet. When Engineer, on basis of test results, approves a system of paving and compacting, do not change compaction procedures. Modify procedure, however, if subsequent testing identifies deficient densities.

3.7 FINISH

- A. Correct all humps or depressions exceeding specified tolerances at no additional cost to the Government. Secure approval for method of correction.
- B. Repair or remove and replace unacceptable paving.

3.8 FIELD QUALITY CONTROL

- A. Test density, thickness and smoothness of in-place bituminous mix in accordance with Section 02505.

END OF SECTION

PART 1 - GENERAL

1.1 **REQUIREMENTS INCLUDED**

- A. Stockpile, and spread topsoil, prepare seed bed and to seed by drill method.
- B. Seed bed preparation includes applying and incorporating fertilizers, ripping, disking seeding, mulching and crimping.

1.2 **RELATED WORK**

- A. Section 02204 - Mineral Aggregate and Fill
- B. Section 02223 - Embankment

1.3 **REFERENCES**

- A. Utah Seed Law
- B. Utah Fertilizer Law
- C. Federal Seed Law

1.4 **DELIVERY, STORAGE, AND HANDLING**

- A. Deliver the grass seed in original containers showing analysis of seed mixture. Wet or otherwise damaged packages are not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer as detailed below or in enclosed bulk containers accompanied by appropriate weigh slips and certifications.
- C. Certificate of inspection must accompany all seed, fertilizer and mulch material.

PART 2 - GENERAL

2.1 **SEED**

- C. Purchase through a dealer licensed with the Utah Department of Agriculture.
- D. Furnished in sealed, undamaged containers and shall be plainly labeled showing:
 - 1. The commonly accepted name of the kind and variety of seed.
 - 2. Lot number.
 - 3. The percentage of pure seed, crop seed, inert matter, weed seeds by weight, and germination and hard seed.
 - 4. The month and year of the germination test.
 - 5. Origin of the seed.
 - 6. The full name and address of the supplier.
 - 7. Name and number of each kind of secondary noxious weed seed as listed in the Utah Seed Law. Seed shall not contain any of the primary noxious weed seeds as designated in the Utah Seed Law.
 - 8. Net weight of seed in each container.
 - 9. The words "poisonous treated" shall appear in bold print on the label of seeds treated with chemicals which are toxic to either humans or livestock.
- E. Furnish one original of a materials certification signed by the vendor prior to initialing seeding operations, prepared by testing laboratory or by a commercial laboratory employing a certified seed analysis technician(s). The seed must have been tested not more than nine months prior to the date of seeding on the Project.

SECTION 02936

SEEDING AND TOPSOIL RESTORATION (DRILLING)

F. Furnish one copy of the seed analysis reports prepared by the respective seed testing laboratory, a tetrazolium viability test is accepted in lieu of the germination portion of the sample seed analysis report prepared by the respective testing laboratory.

G. The table of tolerances acceptable to the State Department of Agriculture is as follows:

OFFERED PERCENTAGE PLS	TOLERANCES (%)
96 or over	-5
90 or over but less than 96	-6
80 or over but less than 90	-7
70 or over but less than 80	-8
60 or over but less than 70	-9
60 or less	-10

H. If the percent PLS (Pure Live Seed) of the delivered seed is below the accepted tolerance, and if tested by the State Seed Laboratory, the State Seed Laboratory test results governs and the seed will be rejected.

I. One or more random samples may be taken during drill seeding operations for testing and analysis by the State Seed Laboratory.

J. The total percentage of "crop seed" shall not exceed 3 percent by weight. Species and varieties of seed, or blends of seeds, shall furnish the PLS at the rates as called for in the seed mixtures. No seed which has less than 85 percent pure seed or less than 80 percent germination will be used.

K. The seed mixtures to be applied are as follows:

PLANT SPECIES RATE	% OF MIX	APPLICATIONS (Pounds PLS/acre)
Hycrest Wheatgrass (<i>Agropyron cristatum</i> x <i>A. desertorum</i>)	30%	9
Western Wheatgrass (<i>Agropyron smithii</i>)	20%	6
Alkali Sacaton (<i>Sporobolus airoides</i>)	10%	3
Sand Dropseed (<i>Sporobolus cryptandrus</i>)	10%	3
Russian Wildrye (<i>Elymus junceus</i> Bozoyskii)	20%	6
Galleta (<i>Hilaria Jamesii</i>)	<u>20%</u>	<u>3</u>
	100%	30/acre

**SECTION 02936
SEEDING AND TOPSOIL RESTORATION (DRILLING)**

- L. Application rates are for drill seeding. Minor broadcast seeding is allowed at an application rate double for drilling.

2.2 FERTILIZER

- A. Use a 2:1:1 ratio (Nitrogen, Phosphorous, Potassium) to supply 35.0 pounds of available nitrogen per acre. Nitrogen shall be derived from organic compounds. Phosphorous and potassium may be derived from any commercially available source.
- B. Weigh slips for bulk fertilizer or tags or bags with the weight indicated for each bag are to be submitted prior to fertilizing operations.

2.3 MULCH

- A. Use grass hay commonly referred to as "native" or "tame pasture" grass hay. Acceptable species include high quality native perennial grasses and such introduced, perennial pasture and meadow grasses as common timothy, orchard grass, smooth brome, and similar species. Grass hay containing crested wheatgrass is not acceptable. All mulch shall be free of noxious weeds or other seed-bearing weeds that would be detrimental to the seeded area.
- B. All materials used as mulch within the State are subject to the inspection and approval of the State Department of Agriculture.
- C. Interstate shipments of mulch material must be accompanied by a certificate from the State of Origin stating that such shipments are free of noxious weed seeds.
- D. All mulch delivered to the site shall be accompanied by a statement of origin and a Certification stating the delivered material is free of noxious weeds.
- E. Apply at the rate of 2.0 tons per acre over the entire disturbed area.

PART 3 - EXECUTION

3.1 GENERAL

- A. Scarify the subsoil, fertilize, scarify this material, and disc. Seeding will be done by the drilling method and will be completed prior to mulching and crimping operations.
- B. Proceed with each revegetation operation in its proper sequence and in a continuous manner. Any delay in the operations (other than weather and related ground conditions) resulting in damage to the prepared slopes or loss of material shall be repaired at the Contractor's expense.
- C. Protect seeded areas from damage by construction traffic equipment. Any area damaged from these causes will be repaired at the expense of the Contractor.

3.2 SEEDING

- A. Accomplish between the time the frost leaves the ground in the spring and before May 10 or after October 1 and the time the frost enters the ground in the fall. Seeding may proceed when there is evidence of frost, providing the seedbed can be kept in a workable condition. If the site is to be left unseeded for more than two weeks, the top material shall be scarified. If a compacted condition exists at the time of seeding, the compacted areas may require additional scarification.
- B. Following scarifying of the top material, disc to a depth of 8 inches to adequately prepare the seedbed. Discing operations shall be done on the contour for sloping areas and perpendicular to the prevailing wind on flat areas.

SECTION 02936

SEEDING AND TOPSOIL RESTORATION (DRILLING)

- C. Drill seeding shall be initiated as soon as possible after discing and shall proceed along slopes and flat areas in the same manner as discing.
- D. Rangeland drills shall be set for uniform rows with the spacing not to be less than 11 inches or more than 13 inches and also set to distribute the seed at the specified application rate. The depth of drilling shall be maintained at approximately 0.5 inches. Seed shall be covered by packer wheels or cover chains. The seed mixture shall be applied at 15.0 pounds Pure Live Seed (PLS) per acre.

- E. Areas to be broadcast seeded shall receive, to the extent possible, the same top material replacement and seedbed preparation as drill seeded areas. Apply with broadcast applicators specifically designed for broadcast seeding. Immediately following broadcasting, cover seed approximately 2 inch to the extent possible by heavy raking or by dragging or chaining. Do not broadcast an area larger than can be immediately (within 15 minutes) raked, dragged, or chained to cover the seed. Broadcast seeding shall not be allowed during excessively windy ground conditions.

3.3 FERTILIZING

- A. Broadcast by equipment specifically designed for application of granular fertilizer. Fertilizer shall be applied before final scarifying, discing, seeding, and mulching operations.

3.4 MULCHING

- A. Spread uniformly over the designated area, leaving no bare acres or thick piles of mulch material. Mulching shall not be allowed during excessively windy ground conditions.
- B. Tub grinders and similar machines are not acceptable and will not be allowed. After the mulch has been spread, it shall be anchored in the soil by means of crimpers, discs, and implements that disc the mulch into the soil rather than crimp will not be allowed. The mulch must be pushed into the topsoil material three or more inches by straight coulters aligned parallel to the movement of the implement. These implements must not be spaced greater than 7.5 inches between coulters.
- C. Crimp on the contour on slopes and perpendicular to the prevailing winds on flat areas. Crimping must immediately follow mulching operations (within approximately two hours or less) to minimize the occurrence of wind blowing the mulch prior to crimping.
- D. Immediately following crimping operations, the Contractor shall place signs around the reseeded area. The signs shall have the written inscription, "Seeded Area, Keep Off". Individual letters on the signs shall be a minimum of three inches high and one inch wide.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form stripping and accessories.

1.2 RELATED SECTIONS

- A. Section 03200 - Concrete Reinforcement
- B. Section 03300 - Cast-in-Place Concrete

1.3 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings
- B. ACI 318 - Building Code Requirements for Reinforced Concrete
- C. ACI 347 - Recommended Practice For Concrete Formwork
- D. PS 1 - Construction and Industrial Plywood

1.4 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, and bracing to conform to code requirements; resultant concrete to conform to required shape, line and dimension.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01000 - Submittals.
- B. Shop Drawings: Fabrication and erection drawings of forms. Show general construction of forms, jointing, location and pattern of form tie placement, and calculations.

1.6 JOB CONDITIONS

- A. For reference purposes, establish and maintain sufficient control points and bench marks to check tolerances. Maintain in an undisturbed condition and until final completion and acceptance of Work.
- B. Regardless of tolerances specified, allow no portion of Work to extend beyond legal boundaries.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Smooth Forms: Faced with material which will produce smooth, hard, uniform texture on concrete.
 - 1. Arrange facing material orderly and symmetrical, keeping number of seams to a practical minimum.
 - 2. Do not use material with raised grain, patches, or other defects which will impair texture of concrete surface.
- B. Form accessories that are to be partially or wholly embedded in concrete are to be a commercially manufactured type:
 - 1. Do not use nonfabricated wire.
 - 2. Use form ties constructed so that ends or end fasteners can be removed without causing appreciable spalling of concrete faces.
 - 3. After ends or end fasteners of form ties have been removed, embedded portion of ties to terminate not less than two diameters from formed faces of concrete, but in no case less than 3/4 inches.
 - 4. Use ties with 3/4 inch diameter cones and 1-1/2-inch break back on both ends for water retaining structures. Ties are to be furnished with a water seal or stop.

**SECTION 03100
CONCRETE FORMWORK**

- C. Premolded Expansion Joint Filler: ASTM D 1751 or D 1752.
- D. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
- E. Fillets for Chamfered Corners: Wood strips 1 x 1 inch size; maximum possible length.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify lines, levels, and measurements before proceeding with formwork.

3.2 FORM CONSTRUCTION

- A. Make forms sufficiently tight to prevent loss of concrete.
- B. Unless indicated otherwise, place chamfer strips in corners of forms to produce beveled edges on permanently exposed exterior corners.
- C. To maintain specified finish tolerances, camber formwork to compensate for anticipated deflections.
- D. Provide positive means of adjustment using wedges, jacks, and struts to take up all settlement during concrete placing operation.
- E. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. At construction joints, overlap forms over hardened concrete at least 6 inches. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain true surface.
- G. Construct wood forms for wall openings to facilitate loosening, or counteract swelling.
- E. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.
- F. Anchor formwork to supporting surfaces or members to prevent upward or lateral movement and deflection of any part of formwork system during concrete placement.
- G. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing.
- H. Position expansion joint material and items accurately and support to prevent displacement.
- I. To prevent entry of concrete, fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material.

3.3 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings for elements embedded in or passing through concrete.
- B. Coordinate work of other sections for the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- C. Install accessories in accordance with manufacturer's instructions. Ensure items are not disturbed during concrete placement.

3.4 FORM FINISHES

- A. Use forms with smooth rubbed, scrubbed, sand floated finishes that meet ACI 347 unless indicated otherwise.
- B. For As-cast Finishes:
 - 1. Install form panels in orderly arrangement with joints planned in approved relation to building elements.
 - 2. Where an as-cast finish is required, no grouting will be permitted in the finishing operation.

3.5 APPLICATION OF FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.

3.6 FORM REMOVAL

- A. Do not pry against face of concrete. Use only wooden wedges.
- B. When repair of surface defects or finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Perform needed repairs or treatment required on such sloping surfaces at once, followed by specified curing.
- D. Loosen wood forms for wall openings as soon as it can be accomplished without damage to concrete.
- E. Formwork for walls and other members not supporting the weight of concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal.

3.7 REMOVAL STRENGTH

- A. When removal of formwork or reshoring is based on concrete reaching a specified strength, it shall be assumed that concrete has reached this strength when either of the following conditions have been met:
 - 1. When test cylinders, field cured along with the concrete they represent, have reached the specified strength.
 - 2. When concrete has been cured for the same length of time as the site-cured cylinders which reached specified strength. Determine the length of time the concrete has been cured in the structure by cumulative number of days or fractions thereof, not necessarily consecutive, during which the air temperature is above 50 degrees F. and concrete has been damp or sealed from evaporation and loss of moisture.

3.8 REUSE OF FORMS

- A. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of concrete surface.
- B. Thoroughly clean and properly coat forms before reuse.

3.9 FIELD QUALITY CONTROL

- A. Before commencing a pour, verify connections, form alignment, ties, and inserts are placed and secure.
- B. Observe formwork continuously while concrete is being placed to verify that the forms are plumb and there are no deviations from desired elevation, alignment, or camber.
- C. If during construction any weakness develops and falsework shows undue settlement or discoloration, stop work, remove affected construction if permanently damaged, and strengthen falsework.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Reinforcing steel bars, wire fabric or rod mats for cast-in-place concrete.

1.2 RELATED SECTIONS

- A. Section 03100 - Concrete Formwork
- B. Section 03300 - Cast-in-Place Concrete

1.3 REFERENCES

- A. ACI 318 - Building Code Requirements For Reinforced Concrete
- B. ACI SP-66 - American Concrete Institute - Detailing Manual
- C. ANSI/ASTM A 82 - Cold Drawn Steel Wire for Concrete Reinforcement
- D. ANSI/ASTM A 184 - Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
- E. ANSI/ASTM A 185 - Welded Steel Wire Fabric for Concrete Reinforcement
- F. ANSI/ASTM A 496 - Deformed Steel Wire Fabric for Concrete Reinforcement
- G. ANSI/ASTM A 497 - Welded Deformed Steel Wire Fabric for concrete Reinforcement
- H. ANSI/AWS D1.4 - Structural Welding code for Reinforcing Steel
- I. ASTM A 615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement
- J. ASTM A 616 - Rail Steel Deformed and Plain Bars for Concrete Reinforcement
- K. ASTM A 617 - Axle Steel Deformed and Plain Bars for Concrete Reinforcement
- L. ASTM A 704 - Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
- M. ASTM A 767 - Zinc-Coated (Galvanized) Bars for Concrete Reinforcement
- N. ASTM A 775 - Epoxy-Coated Reinforcing Steel Bars
- O. AWS D12.1 - Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete Construction
- P. CRSI - Concrete Reinforcing Steel Institute - Manual of Practice
- Q. CRSI 63 - Recommended Practice For Placing Reinforcing Bars
- R. CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications and Nomenclature

1.4 SUBMITTALS

- A. Submit under provisions of Section 01000 - Submittals.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Welder's certification.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with CRSI 63, 65 and Manual of Practice.
- B. Maintain one copy of each document on site.
- C. Submit certified copies of mill test report of reinforcement materials analysis.
- D. Provide Contracting Officer with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

1.6 QUALIFICATIONS

- A. Design reinforcement under direct supervision of the Contracting Officer experienced in design of this work and licensed in the State of the Project.

**SECTION 03200
CONCRETE REINFORCEMENT**

- B. Welders' Certificates: Submit provisions certifying welders employed on the Work, verifying AWS qualification within the previous twelve months.

1.7 COORDINATION

- A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A 615, 60 ksi yield grade; deformed billet steel bars, unfinished.
- B. Reinforcing Steel Mat: ASTM A 775, ASTM A615, 60 ksi yield grade; steel bars, epoxy-coated.
- C. Stirrup Steel: ASTM A 615, 60 ksi yield grade, epoxy-coated.
- D. Welded Steel Wire Fabric: ASTM A 185 Plain Type in flat sheets; unfinished.

2.2 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.

2.3 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice.
- B. Weld reinforcement in accordance with ANSI/AWS D1.4.

PART 3 - EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Maintain concrete cover around reinforcing as follows:

<u>Item</u>	<u>Coverage</u>
Walls	1-1/2 inches
Slabs on Fill	3 inches
Exposed to atmosphere	1-1/2 inches minimum
- C. Reinforcement shall be welded and grounded to counterpoise system.

3.2 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01000 - Quality Control.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Joints and joint sealants in horizontal traffic surfaces for cast-in-place concrete sidewalks, curb, gutter and pavement slabs.

1.2 REFERENCES

- A. ASTM C 920: Standard Specifications for Elastomeric Joint Sealants
- B. ASTM D 545: Standard Methods of Testing Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types)
- C. ASTM D 994: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
- D. ASTM D 1056: Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
- E. ASTM D 1190: Standard Specification for Concrete Joint Sealer, Hot-Poured Elastic Type
- F. ASTM D 1191: Standard Method for Testing Concrete Joint Sealer
- G. ASTM D 1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- H. ASTM D 1752: Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- I. ASTM D 1850: Standard Specification for Concrete Joint Sealer, Cold-Application Type
- J. ASTM D 1851: Standard Methods of Testing Concrete Joint Sealers, Cold-Application Type
- K. ASTM D 2240: Standard Test Method for Rubber Property Durometer Hardness
- L. ASTM D 2628: Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavement
- M. ASTM D 3406: Standard Specification for Joint Sealant, Hot Applied, Elastomeric-Type, for Portland Cement Concrete Pavements
- N. ASTM D 3407: Standard Methods of Testing Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements
- O. ASTM D 3408: Standard Methods of Testing Joint Sealants, Hot Poured, Elastomeric-Type, for Portland Cement Concrete Pavements
- P. ASTM D 3542: Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Bridges
- Q. ASTM D 3569: Standard Specification for Joint Sealant, Hot Applied, Elastomeric, Jet-Fuel-Resistant Type, for Portland Cement Concrete Pavements
- R. ASTM D 3581: Standard Specification for Joint Sealant, Hot Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete Tar-Concrete Pavements
- S. ASTM D 3582: Standard Methods for Testing Joint Sealant, Hot Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements
- T. ASTM D 3583: Standard Methods of Testing Joint Sealant, Hot Applied, Elastomeric-type, for Portland Cement Concrete Pavements, or Joint Sealant, Hot Applied, Elastomeric, Jet-Fuel-Resistant-Type, for Portland Cement Concrete Pavement
- U. FS SS-S-200: Sealants, Joint, Two Component, Jet-Blast Resistant, Cold-Applied, for Portland Cement Concrete Pavement

1.3 SYSTEM PERFORMANCES

- A. Pavement joints include longitudinal and transverse expansion joints, contraction joints, construction joints, and crack control joints.
- B. Provide joint sealants that maintain watertight and airtight continuous seals.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01000 - Submittals.

**SECTION 03251
EXPANSION AND CONTRACTION JOINTS**

- B. Manufacturer's certification that product was manufactured, tested and supplied in accordance with source quality control requirements specified herein, together with a report of the test results and the date each test was completed.
- C. Manufacturer's instruction for joint preparation, type of cleaning and installation.
- D. Manufacturer's Product Data and Samples for each joint sealant product required.
- E. Safety data sheets.

1.5 QUALITY ASSURANCE

- A. Obtain joint sealing materials from a single manufacturer for each different product required.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original unopened containers or bundles with labels identifying manufacturer, product name and designation, color, expiration period for use, pot life, cure time, and mixing instruction for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent deterioration; or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Compatibility: Provide joint fillers, sealant backings, sealants, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.2 JOINT VOID - FORMER

- A. Plastic with a water stop.
- B. 1/4 depth of concrete structural section.

2.3 JOINT FILLER - SHEET TYPE

- A. F1 Joint Filler: Bituminous (asphalt or tar) mastic in accordance with ASTM D 994; formed and encased between 2 layers of bituminous saturated felt or 2 layers of glass-fiber felt.
- B. F2 Joint Filler: Cane or other cellulosic fiber in accordance with ASTM D 1751; saturated with asphalt.
- C. F3 Joint Filler: Granulated cork in accordance with ASTM D 1751; in an asphalt binder; encased between 2 layers of asphalt saturated felt or 2 layers of glass-fiber felt.
- D. F4 Joint Filler: Sponge rubber fully compressible in accordance with ASTM C 1752; with resiliency recovery rate of 90 percent minimum.
- E. F5 Joint Filler: Cork in accordance with ASTM C 1752; impregnated and bound with asphalt; compressible with resiliency recovery rate of 90 percent if not compressed more than 50 percent of original thickness.
- F. F6 Joint Filler: Plastic foam (for cold-applied sealants only) preformed, compressible, resilient, nonwaxing, nonextruding strips of flexible, nongassing plastic foam; nonabsorbent to water and gas; 30 lb/ft³ density maximum; and of size and shape to control sealant depth and performance.

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2.4 JOINT FILLER - BACKER ROD AND TAPE TYPE

- A. Elastomeric Tube (Backer Rod): Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to -26 degrees F. Provide product with low compression set and of size and shape to provide a secondary seal, to prevent 3-sided adhesion and control sealant depth, and otherwise contribute to optimum sealant performance.
- B. Tape: Self-adhesive polyethylene bond breaker tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to joint filler materials or joint surfaces at back or bottom of joint.

2.5 JOINT SEALANT - GENERAL

- A. Color of exposed joint sealant indicated, of if not, as selected from manufacturer's standard colors.

2.6 JOINT SEALANT - HOT APPLIED

- A. HAS1 Sealant: Resilient and adhesive compound type in accordance with ASTM D 3405; for Portland cement concrete or asphalt concrete pavements.
- B. HAS2 Sealant: Thermoplastic type in accordance with ASTM D 3581; jet-fuel resistant without rubber unless indicated otherwise.
- C. HAS3 Sealant: Elastic type in accordance with ASTM D 1190.
- D. HAS4 Sealant: Elastomeric type in accordance with ASTM D 3406; 1 component, for Portland cement concrete pavements.
- E. HAS5 Sealant: Elastomeric type in accordance with ASTM D 3569; 1 component, jet-fuel resistant, for Portland cement concrete pavements.

2.7 JOINT SEALANT - COLD-APPLIED

- A. CAS1 Sealant: Elastomeric type in accordance with ASTM C 920 and TT-S-00227 E; chemically curing, for vehicular or pedestrian use, and types of construction other than highway and airfield pavements and bridges and joint substrates indicated; Type S or M; Grade P or NS; Class 25; Use T, NT, M and O.
 - 1. Self Leveling
 - 2. Shore A Hardness: 40 ∇ 5 ASTM D 2240
 - 3. Final cure: 4 days maximum.
 - 4. Service range: -40 to 170 degrees F
 - 5. Tack-Free time: 6 - 8 hours.
 - 6. Adhesion-Bond/Peel: Concrete 30 pli TT-S-00227 E.
 - 7. Durability-Joint Movement Capability: ∇ 50%.
 - 8. Tear Strength: 100 lb/in. ASTM D 624.
- B. CAS2 Sealant: Mastic type in accordance with ASTM D 1850; single or multiple component; for joints having a minimum width of 1/2 inch.
- C. CAS3 Sealant: Coal-tar modified urethane type in accordance with FS SS-S-200; 1 part, jet fuel resistant; Type II.
- D. CAS4 Sealant: Elastomeric preformed polychloroprene type with lubricant adhesive and indicated movement ratio.
 - 1. For concrete pavement seal; ASTM D 2628
 - 2. For concrete bridge seals; ASTM D 3542

2.8 SOURCE QUALITY CONTROL

- A. Preformed Expansion Joint Fillers: Nonextruding and resilient types: ASTM D 545.
- B. Hot-Applied Joint Sealants:

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1. Elastic type used in concrete pavements, bridges, other structures; ASTM D 1191.
2. Bituminous type for hydraulic and asphaltic concrete pavements; ASTM D 3407.
3. Elastomeric type for hydraulic concrete pavement; ASTM D 3408.
- C. Jet-Fuel-Resistant Joint Sealant Cold-Applied: Hot-applied; ASTM D 3582 and ASTM D 3583.
- D. Cold-Applied Mastic Joint Sealant: In accordance with ASTM D 1851.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation of joint sealants under unfavorable weather conditions.
- B. Install elastomeric sealants when temperature is stable in temperature range recommended by manufacturer for installation.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.

3.2 PREPARATION

- A. Clean, prepare, and size joints in accordance with manufacturer's instructions. Remove any loose materials and other foreign matter which might impair adhesion of sealant.
- B. Verify that joint shaping materials and release tapes are compatible with sealant.
- C. Examine joint dimensions and size materials to achieve required width to depth ratio.
- D. Adjust joint depths to allow sealants to perform properly.
- E. Substrate must be completely dry for CAS1 sealant application.
- F. Bond Breaker Tape: Install where needed or required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

3.3 JOINTS - GENERAL

- A. Construct all joints as follows.
 1. At right angles to top surface of placement.
 2. Straight unless indicated otherwise.
 3. Before uncontrolled shrinkage cracking takes place.
 4. To prevent concrete edge slump.

3.4 EXPANSION JOINTS

- A. Set joint fillers at proper depth or position in joint to coordinate with other work, including installation of bond breakers, backer rods, and sealants. Do not leave voids or gaps between ends of joint filler units. Secure holders and supports to prevent joint filler movement.
- B. Form transverse expansion joints at structures and concrete approaches using filler strips, backer rods and joint sealant. Support as needed with holders which will remain in place.

3.5 CONSTRUCTION JOINTS

- A. Construction joints (contact joints) are those made by placing concrete against cured concrete. When indicated construct construction joints with an indented keyway or tie-bar.
- B. Place tie-bars to eliminate edge slump.
- C. Maintain tie bars perpendicular to joint unless indicated otherwise. Before placing concrete in adjoining slab, straighten tie bars to proper position. If an "S" shape bend results from straightening, the offset from a straight line cannot exceed 0.1 feet.

**SECTION 03251
EXPANSION AND CONTRACTION JOINTS**

3.6 CONTRACTION CRACK CONTROL JOINTS

- A. Joint spacing in feet shall not exceed twice the slab thickness in inches. Regardless of the thickness, joint spacing shall not exceed 50 feet.
- B. Contraction crack control joints are those made by sawing or tooling joints 1/4 depth of concrete structural section and 3/8 inch wide. Use of a plastic control joint-void former is acceptable in lieu of saw cutting or tooling.
- C. Make longitudinal joints the same dimension as transverse joints.
- D. Except where shown to be omitted or recommended to be omitted by sealant manufacturer, clean saw cut or tooled joint of loose debris, cement, dust, etc.; install 25 percent oversized backer rod to fit tightly in joint and seal joint.

3.7 JOINT SEALING

- A. Surface Preparation:
 - 1. Remove oil, grease, wax, form-release-agents, curing compounds, bitumens, laitance and old caulking material by sandblast, or water blast as recommended by manufacturer of sealant. Maximum sand blast angle, 25 degrees ∇ 5.
 - 2. Clean and dry with air blast. Do not contaminate air blast with oils or lubricants.
 - 3. Remove frost and moisture in concrete joint substrates before commencing sealing.
- B. Installation:
 - 1. Ensure that sealants are installed in uniform, continuous ribbons without gaps or air pockets, with complete bonding of joint surfaces on opposite sides.
 - 2. Except as otherwise indicated, fill sealant rabbet flush with surface.
 - 3. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.
- C. Depths: Saw cut joints if necessary to provide the required sealant thickness and depth. Install sealant to depths indicated or, if not indicated, as recommended by sealant manufacturer, but within the following general limitations measured at center (thin) section of bead:
 - 1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, but neither more than 5/8 inch deep nor less than 3/8 inch deep.
 - 2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
 - 3. For joints sealed with nonelastomeric sealants and caulking compounds, fill joints to a depth in range of 75 percent to 125 percent of joint width.
- D. Spillage: Do not allow poured sealant compound to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces. Clean adjoining surfaces to eliminate evidence of spillage.
- E. Heating: Do not overheat hot-applied sealants.
- F. Edges: Unless indicated otherwise, recess exposed edges of gasket and exposed joint fillers slightly behind adjoining surfaces so compressed units will not protrude from joints.

3.8 CURE AND PROTECTION

- A. Cure sealants and caulking compounds in accordance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.
- B. Follow procedures required for cure and protection of joint sealants during construction period so they will be without deterioration or damage (other than normal wear and weathering) at time of Substantial Completion.

3.9 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses. Use methods and cleaning materials approved by manufacturer's of joint sealant and of products in which joints occur.
- B. Remove protective coating and oil from metals with solvent recommended by the sealant manufacturer.

**SECTION 03251
EXPANSION AND CONTRACTION JOINTS**

3.10 PROTECTION

- A. Protect joint sealant during and after curing period from contact with contaminating substances or from damage resulting from deterioration or damage at time of Substantial Completion.
- B. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work at no additional cost to the Government.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Portland cement concrete material requirements.
- B. Mix design requirements.
- C. Schedule of indented use and Classification.

1.2 RELATED SECTIONS

- A. Section 03100 - Concrete Formwork
- B. Section 03200 - Concrete Reinforcement

1.3 REFERENCES

- A. AASHTT 26: Standard Method of Test for Quality of Water to be Used in Concrete
- B. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- C. ACI 211.2: Standard Practice for Selecting Proportions for Structural Lightweight Concrete
- D. ACI 211.3: Standard Practice for Selecting Proportions for No-Slump Concrete
- E. ACI 214: Recommended Practice for Evaluation of Strength Test Results of Concrete
- F. ACI 301: Specifications for Structural Concrete for Buildings
- G. ASTM C 33: Standard Specification for Concrete Aggregates
- H. ASTM C 88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- I. ASTM C 94: Standard Specification for Ready-Mixed Concrete
- J. ASTM C 150: Standard Specification for Portland Cement
- K. ASTM C 260: Standard Specification for Air-Entraining Admixtures for Concrete
- L. ASTM C 289: Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
- M. ASTM C 494: Standard Specification for Chemical Admixtures for Concrete
- N. ASTM C 618: Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

1.4 DEFINITIONS

- A. Average Strength (f_{cr}): The required average strength for 30 consecutive strength tests which statistically assures no more than the permissible proportions of tests will fall below Specified Strength.
- B. Specified Strength (f'_c): The indicated strength.

1.5 SUBMITTALS

- A. Submit under provisions of section 01000.
- B. Mix Design: Submit each proposed mix design 14 days prior to use in the Work. Indicate whether mixes have been designed for pumping. Include in the report the following information.
 - 1. Water-cement ratio.
 - 2. Proportion of materials in the mix.
 - 3. Source and type of cement.
 - 4. Analysis of water to be used unless potable.
 - 5. Type and name of admixtures applied. Indicate when accelerating or retarding admixtures are to be used and the resulting change in placement times.
 - 6. Slump, air content and temperature of samples.
 - 7. Unit weight of fresh and dry light weight concrete.
- C. Concrete Quality Charts. Comply with ACI 214 and ACI 301, and submit the following.
 - 1. Specified strength (f'_c).
 - 2. Required average strength (f_{cr}).

**SECTION 03300
CAST-IN-PLACE CONCRETE**

- 3. Compressive strength versus date of sample.
- D. Preapproved Mix Design Data: If supplier has on record a Government approved mix design, submit name and address of supplier for each mix design one day prior to using concrete mix.
- E. Aggregate Test Report: Submit for each aggregate source.
 - 1. Date of test analysis
 - 2. Sieve analysis
 - 3. Organic impurities
 - 4. Sodium sulfate soundness test
 - 5. Reactivity of aggregate

1.6 QUALITY ASSURANCE

- A. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures, or aggregate without Contracting Officer's approval.
- B. In proportioning materials for mixing, use scales certified by the State of the Project. Do not use volume measurement except for water and liquid admixtures.
- C. Do not change the quantity of cement per cubic yard from approved mix design without written approval of Contracting Officer.
- D. Use of admixtures will not relax hot or cold weather placement requirements.
- E. Ready-mixed concrete to be in accordance with Alternate No. 3 of ASTM C 94 and requirements in this Section.
- F. Control Testing of Concrete: In accordance with Section 03305.

1.7 PRODUCT STORAGE AND HANDLING

- A. Store bagged and bulk cement in weatherproof enclosures to exclude moisture and contaminants.
- B. Stockpile aggregate to avoid segregation and prevent contamination.
- C. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

PART 2 - PRODUCTS

2.1 CEMENT

- A. ASTM C 150, Type II (modified). Type I may be used in above grade structure if approved.
- B. Do not use air entraining cement.

2.2 WATER

- A. Clean, nonstaining and nondetrimental. Comply with AASHTO T 26.

2.3 AGGREGATES - GENERAL

- A. Gravel, crushed slag, crushed stone, or other inert materials, composed of hard, strong, durable particles free of injurious coatings.
- B. The materials passing the No. 200 sieve shall not exceed 1.75 percent by weight in the combined coarse and fine aggregate.

2.4 COARSE AGGREGATE

- A. Sieve Analysis: Graded in accordance with ASTM C 33, as indicated in Table No. 03300-2.04.
- B. Gradation limits of Table No. 03300-2.04 may be changed if, in the judgment of the Contracting Officer, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids and the maximum aggregate size does not exceed the following requirements.

**SECTION 03300
CAST-IN-PLACE CONCRETE**

1. 1/5 of narrowest dimension between forms.
 2. 1/3 of depth of slabs.
 3. 3/4 of minimum clear spacing between reinforcing bars.
- C. Deleterious Substances: Maximum percentage by weight.
1. Soft Fragments: 2.0 percent
 2. Coal and Lignite: 0.3 percent
 3. Clay Lumps: 0.3 percent
 4. Other Deleterious Substances: 2.0 percent.

TABLE No. 03300-2.4

MASTER GRADING BAND LIMITS FOR COARSE AGGREGATE						
SIEVE SIZES	COARSE AGGREGATE Percent Passing by Weight					
	Grade 67		Grade 57		Grade 67	
	Min	Max	Min	Max	Min	Max
2 Inch	100	C	C	C	C	C
1 1/2 Inch	95	100	100	C	C	C
1 Inch	C	C	95	100	100	C
3/4 Inch	35	70	C	C	90	100
2 Inch	C	C	25	60	C	C
3/4 Inch	10	30	C	C	20	55
No. 4	0	5	0	10	0	10
No. 8	C	C	0	5	0	5

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2.5 FINE AGGREGATE

- A. Sieve Analysis: Graded in accordance with ASTM C 33, as follows.

TABLE No. 03300-2.5

MASTER GRADING BAND LIMITS FOR FINE AGGREGATE		
SIEVE SIZES	FINE AGGREGATE Percent Passing by Weight	
	Min	Max
d Inch	100	c
No. 4	95	100
No. 16	45	80
No. 50	10	30
No. 100	2	10

- B. Deleterious Substances: Maximum percentage by weight.
1. Coal and Lignite: 0.3 percent
 2. Clay Lumps: 0.5 percent
 3. Other Deleterious Substances: 2.0 percent

2.6 SOUNDNESS AND REACTIVITY OF AGGREGATE

- A. Determine coarse and fine aggregate soundness in accordance with ASTM C 88.
1. For Coarse Aggregate: Weight loss; not exceeding 12 percent by weight when subjected to 5 cycles of sodium sulfate or 18 percent by weight when subject to 5 cycles of magnesium sulfate.
 2. For Fine Aggregate: Weight loss; not exceeding 10 percent by weight when subjected to 5 cycles of sodium sulfate or 15 percent by weight when subjected to 5 cycles of magnesium sulfate.
- B. Determine alkali-silica reactivity in accordance with ASTM C 289. Do not use aggregates determined either potentially or actually deleterious unless service records have shown the aggregates to be innocuous and Engineer approves.

2.7 ADMIXTURES

- A. Air Entrainment: ASTM C 260
- B. Water Reducing and Set Retarding Agents: ASTM C 494
 - 1. Type A: Set water reducing
 - 2. Type B: Set retarding
 - 3. Type C: Set accelerating
 - 4. Type D: Water reducing and set retarding
 - 5. Type E: Water reducing and set accelerating
 - 6. Type F: High range water reducing (super plasticizer) *
 - 7. Type G: High range water reducing and set retarding *

*The relative durability factor of water reducing admixtures shall not be less than 80 and the chlorides contents (as Cl-) shall not exceed 1 percent by weight of the admixtures.
- C. Calcium Chloride: None allowed.
- D. Pozzolan: Pozzolan conforming to the requirements of ASTM C 618, Class F, is allowed as a Portland cement replacing agent under the following conditions:
 - 1. The maximum percentage of Portland cement replacement is:
 - a) 15 percent, for concrete exposed to weather.
 - b) 20 percent, for interior concrete.
 - 2. The ratio of replacement by weight of Pozzolan to cement shall be 1.25 to 1.0.
 - 3. The minimum cement content shall be used in the design formulas before replacement is made.
 - 4. Loss of ignition of pozzolan is less than 3 percent and the water requirement does not exceed 100 percent.
 - 5. All other requirements of this section still apply.
 - 6. Mix designs including trial batches are required for each aggregate source and for each concrete class.

2.8 ACI MIX DESIGN

- A. The amount by which the average strength (f_{cr}) of a concrete mix exceeds the specified compressive strength (f_c') shall be based upon no more than 1 in 100 random individual strength tests falling more than 500 psi below the specific strength.
- B. Proportion the materials in accordance with ACI 211.1, 211.2 or 211.3 as applicable to produce concrete having the properties or limitations of Table No. 03300-2.8.

2.9 HAND MIXING

- A. Do not hand mix batches exceeding 0.5 cubic yards.
- B. Hand mix only on watertight platform. Mix cement and aggregate prior to adding water.
- C. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency.

2.10 HEATING, WATER AND AGGREGATE

- A. Do not allow products of fuel combustion to contact the aggregate.
- B. Heat mixing water to 150 degrees F maximum. Heat aggregates uniformly.
- C. Do not mix cement with water and aggregate at a mix temperature greater than 100 degrees

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CAST-IN-PLACE CONCRETE**

TABLE No. 03300-2.8

CONCRETE MIX PROPERTIES						
CONCRETE PROPERTIES	CONCRETE CLASSIFICATION					
	Class 7000	Class 6000	Class 5000	Class 4000	Class 3000	Class 2000
Specified Compressive Strength f'_c at 28 days, min., psi	7000	6000	5000	4000	3000 (f)	2000 (f)
Compressive Strength at 7 days, psi, min. (a)	4690	4020	3350	2680	2010	1340
Cement content (94 lb. Sacks of cement per cubic yard of concrete), min. (b)	(c)	(c)	(c)	6.0	5.5	4.5
Entrained air content, (% by volume)	(d)	(d)	(d)	6 ∇ 1	6 ∇ 1	4.5
Slump Range, in. (e)	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4	2 - 5

- (a) Used for monitoring purposes only.
- (b) Includes pozzolan replacements.
- (c) Cement content shall be appropriate to produce a mixture meeting the requirements for water/cement ratio and workability for the specific job conditions.
- (d) Air content shall be appropriate to the exposure conditions.
- (e) Not more than 8 inches after adding high range water reducing admixture (super-plasticizer) at site.
- (f) Not allowed if concrete is exposed to freezing and thawing temperatures. Use Class 4000 or higher compressive strength and 6 ∇ 1.0 percent air entrainment.

**SECTION 03300
CAST-IN-PLACE CONCRETE**

PART 3 - EXECUTION

3.1 PLACEMENT SCHEDULE

- A. Use the type and strength requirements shown on Table 3300-3.1.

TABLE No. 03300-3.1

SCHEDULE OF CONCRETE STRENGTH		
Specified Use	Type of Concrete	Class
Foundation Walls	Regular Weight	3000
Wall Footings	Regular Weight	3000
Column Footings	Regular Weight	3000
Interior Slab on grade	Regular Weight	3000
Caissons	Regular Weight	3000
Concrete Columns	Regular Weight	4000
Grade Beams	Regular Weight	4000
Supported Slabs	Regular Weight	4000
Metal Deck	Light Weight	4000
Exterior Slab on grade	Regular Weight	4000
Liquid Holding Tanks	Regular Weight	4000
Sidewalk-Curb-Gutter	Regular Weight	4000
Misc. Structure	Regular Weight	4000
Box Culverts	Regular Weight	4000
Concrete Pavement	Regular Weight	4000

END OF SECTION

PART 1 - GENERAL

1.1 **SECTION INCLUDES**

- A. Finishing interior and exterior concrete surfaces.

1.2 **REFERENCES**

- A. ACI 303: Guide to Cast-in-place Architectural Concrete Practice

1.3 **SUBMITTALS**

- A. Name, type, chemical analysis and manufacturer's recommended rate of application for liquid chemical hardener.

1.4 **PROJECT CONDITIONS**

- A. Protect adjacent materials and finishes from dust, dirt and other surface or physical damage during finishing operations. Provide protections as required and remove from site at completion of work.

PART 2 - PRODUCTS

2.1 **MATERIALS**

- A. Mortar and Grout
- B. Dry Shake: Blend of metallic or mineral aggregate with Portland cement concrete in proportions recommended by manufacture.
- C. Proprietary Materials: If permitted or required, proprietary compounds may be used in lieu of or in addition to foregoing materials. Use such compounds in accordance with manufacturer's recommendations.
- D. Liquid-Chemical Hardener: Colorless, aqueous solution containing a blend of magnesium fluosilicate, zinc fluosilicate and a wetting agent. Mixture contains not less than 2 pounds fluosilicate per gallon and does not interfere with adhesives and bonding of finishes where such is indicated.

PART 3 - EXECUTION

3.1 **PREPARATION**

- A. Examine the areas and conditions under which work of this section will be performed.
- B. Correct conditions detrimental to timely and proper finishing.
- C. Do not proceed until unsatisfactory conditions are corrected.

3.2 **FINISHING OF FORMED SURFACES**

- A. General:
 - 1. Allow concrete to cure not more than 72 hours before commencing surface finish operations, unless approved otherwise.
 - 2. Revise the finishes as needed to secure approval.
- B. As-Cast Form Finish:
 - 1. Rough: Patch defects, chip or rub off fins exceeding 1/4 inch height.
 - 2. Smooth: Patch tie holes and defect and remove fins completely.
 - a) When surface texture is impaired and form joints misaligned, grind, bushhammer, or correct affected concrete.
 - b) Slurry grout areas evidencing minor mortar leakage to match adjacent concrete.
 - c) Repair major mortar leakage as a defective area.

**SECTION 03345
CONCRETE FINISHING**

- d) When workmanship is less than acceptable standard, provide one of rubbed finishes at no additional cost to Government.
- C. Rubbed Finish:
- 1. Smooth Rubbed: Remove forms and perform necessary patching as soon after placement as possible.
 - a) Finish newly hardened concrete no later than 24 hours following form removal.
 - b) Wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced.
 - 2. Grout Cleaned: Undertake no cleaning operations until all contiguous surfaces are completed and accessible.
 - a) Wet surface of concrete sufficiently to prevent absorption of water from grout.
 - b) Apply grout uniformly.
 - c) Immediately after grouting, scrub surface with cork float or stone to coat surface and fill voids.
 - d) While grout is still plastic, remove excess grout by working surface with rubber float or sack.
 - e) Keep damp for at least 36 hours after final rubbing.
 - 3. Cork Floated: Remove forms within 2 to 3 days of placement where possible.
 - a) Remove ties.
 - b) Remove all burrs and fins.
 - c) Dampen wall surface.
 - d) Apply mortar with firm rubber float or with trowel, filling all surface voids.
 - e) Compress mortar into voids.
 - f) If mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with fog sprayer.
 - g) Produce final texture with cork float using a swirling motion.
- D. Uniformed Finish:
- 1. After concrete is placed, strike smooth, tops of walls or buttresses, horizontal offsets, and similar uniformed surfaces occurring adjacent to formed surfaces.
 - 2. Float to texture which is reasonably consistent with formed surfaces.
 - 3. Continue final treatment on formed surfaces uniformly across uniformed surfaces.
- E. Blasted Finish:
- 1. Perform abrasive blasting within 24 to 72 hours after casting.
 - 2. Coordinate with form work construction, concrete placement schedule, and formwork removal to ensure that surfaces are blasted at the same age for uniform results.
 - 3. Reapply curing protection after blast finishing
- F. Architectural Finish:
- 1. General: In accordance with ACI 303.
 - 2. Tooled Finish:
 - a) Dress thoroughly cured concrete surface with electric, air, or hand tools to uniform texture, and give a bush hammered surface texture.
 - b) Remove sufficient mortar to exposed coarse aggregate for tooled finish.
- G. Patched Finish:
- 1. Repair defective areas.
 - a) Remove honeycomb and defective concrete to sound concrete.
 - b) Make edges perpendicular to surface or slightly undercut.
 - c) Feathered edges are not permitted.
 - d) Dampen area to be patched and at least 6 inches surrounding it to prevent absorption of patching mortar water.
 - e) Prepare bonding grout.
 - f) Mix to consistency of thick cream.
 - g) Brush into surface.
 - 2. Tie Holes: Unless indicated otherwise, after being cleaned and thoroughly dampened, fill tie hole solid with patching mortar.

**SECTION 03345
CONCRETE FINISHING**

3. Make any patches in concrete to closely match color and texture of surrounding surfaces. Determine mix formula for patching mortar by trial and obtain a good color match with concrete when both patch and concrete are cured and dry.
 - a) Mix white and gray Portland cement as required to match surrounding concrete to produce grout having consistency of thick paint.
 - b) Use a minimum amount of mixing water.
 - c) Mix patching mortar in advance and allow to stand without frequent manipulation, without addition of water, until it has reached stiffest placeable consistency.
 - d) After initial set, finish surface of patches manually to obtain same texture as surrounding surfaces.
4. After surface water has evaporated from patch area, brush bond coat into surface.
 - a) When bond coat begins to lose water sheen, apply patching mortar.
 - b) Thoroughly consolidate mortar into place and strike-off to leave patch slightly higher than surrounding surface.
 - c) Leave undisturbed for at least 1 hour before final finish.
 - d) Keep patched area damp for 72 hours or apply curing compound.
 - e) Do not use metal tools in finishing an exposed patch.
5. Where as-cast finishes are indicated, total patched area may not exceed 1 in 500 of as-cast surface. This is in addition to form tie patches, if ties are permitted to fall within as-cast areas.
6. In any finishing process which is intended to expose aggregate on surface, patched areas must show aggregate.
 - a) Outer 1 inch of patch shall contain same aggregates as surrounding concrete.
 - b) For aggregate transfer finish, patching mixture shall contain same selected colored aggregates.
 - c) After curing, expose aggregates together with aggregates of adjoining surfaces by same process.

3.3 FINISHING SLABS

- A. Slab Finishing Tolerances:
 1. Class A finish: 1 in 1000
 2. Class B finish: 1 in 500
 3. Class C finish: 1 in 250
- B. Broom or Belt Finish: After concrete has been placed, consolidated, struck-off, and leveled to the required tolerance, roughen surface transversely with stiff brushes, rakes, or burlap belt before final set.
- C. Floated Finish: After concrete has been placed, consolidated, struck-off, and leveled, do not work further until ready for floating.
 1. Begin floating when water sheen has disappeared and surface has stiffness sufficient to permit operation.
 2. During or after first floating, check planeness of entire surface with a 10 feet long straightedge applied at 2 more different angles.
 3. Cut down high spots and fill low spots to the required tolerance.
 4. Refloat slab immediately to a uniform sandy texture.
- D. Trowel Finish:
 1. Float finish surface.
 2. Power trowel.
 3. Hand trowel as required to provide surface. Do not apply water (i.e. sprinkle) to surface of concrete in finishing operations.
 4. First troweling after power floating shall produce smooth surface relatively free to defects but which may still show some trowel marks.
 5. Second trowel by hand after surface has hardened.
 6. Leave finished surface essentially free to trowel marks, uniform in texture and appearance.
 7. On surfaces intended to support floor coverings, grind off defects which would show through floor covering.
- E. "Dry Shake" Finish: Give surface a floated finish.
 1. Apply approximately 2/3 of a blended material for required coverage to surface by a method that ensures even coverage without segregation.

**SECTION 03345
CONCRETE FINISHING**

2. Begin floating immediately after application of first "dry shake".
 3. After material has been embedded by floating, apply remainder of blended material to surface at right angles to previous application.
 4. Make second application heavier in any areas not sufficiently covered by first application.
 5. Immediately follow with second floating.
 6. After selected material has been embedded by second floating, complete operation with a broomed, floated, or troweled finish, as indicated.
- F. Nonslip Finish: Give surface a "dry shake" application, using crushed ceramically bonded aluminum oxide particles. Apply at 25 pounds per 100 square feet.
- G. Exposed Aggregate Finish: Immediately after surface of concrete has been leveled to tolerance and surface water has dissipated, spread aggregate uniformly over surface to provide complete coverage to the depth of a single stone.
1. Embed aggregate into surface by light tamping.
 2. Float surface until embedded aggregate is fully coated with mortar and surface has been brought tolerance.
 3. Start exposure of aggregate after matrix has hardened sufficiently to prevent dislodgment.
 4. Flow ample quantities of water, without force, over surface of concrete while matrix encasing aggregate is removed by brushing with a fine bristle brush.
 5. Continue until aggregate is uniformly exposed.
 6. An approved chemical retarder sprayed onto freshly floated surface may be used to extend working time.
- H. Chemical-Hardener Finish: Apply liquid chemical-hardener finish to interior concrete floors where indicated. Do not apply liquid chemical hardener on floor areas scheduled to receive synthetic matrice terrazzo, setting beds for tile, terrazzo, vinyl flooring, or like items. Apply hardener after complete curing and drying of concrete surface in accordance with manufacturer's recommendations. Evenly apply each coat, and allow 24 hours for drying between coats. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide precast reinforced structural concrete units for building structure:
 - 1. Igloo roof panels.
 - 2. Igloo wall panels.

1.2 SUBMITTALS

- A. Submit for approval shop drawings, product data, test reports.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Casting: Site Cast.
- C. Casting: Plant Cast:
- D. Standards: ACI 318 Building Code Requirements for Reinforced Concrete, and CRSI Manual of Standard Practice.
- E. Testing: Independent testing laboratory
- F. Erection Tolerance Limits: PCI MNL 127

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Design Mix:
 - 1. Class 4000, 28 days compressive strength for wall panels and roof panels
- B. Form Work: Plywood or metal panel formwork sufficient for structural and visual requirements
- C. Reinforcing Materials:
 - 1. Reinforcing Bars: ASTM A 615, Grade 50, deformed
 - 2. Reinforcing Bars: ASTM A 706
 - 3. Reinforcing Bars: ASTM A 767, Class II, galvanized
 - 4. Steel Wire: ASTM A 82
 - 5. Steel Wire Fabric: ASTM A 185, welded
 - 6. Steel Wire Fabric: ASTM A 497, welded, deformed
 - 7. Supports for Reinforcement for Exposed to View Concrete: CRSI Class 1, plastic protected legs.
 - 2. Supports for Reinforcement for Exposed to View Concrete: CRSI Class 2, stainless steel protected legs.
- D. Concrete Materials: ASTM C 150, Type II, Portland cement; potable water
 - 1. Normal weight aggregates: ASTM C 33
 - 2. Fly Ash: ASTM C 618, Class C or F
- E. Concrete Admixtures: Containing less than 0.1 percent chloride ions
 - 1. Air-Entraining Admixture: ASTM C 260
 - 2. Water-Reducing Admixture: ASTM C 494, Type A
- F. Connection Materials:
 - 1. Steel Plate: ASTM A 36
 - 2. Steel Shapes: ASTM A 36
 - 3. Anchor Bolts: ASTM A 307
 - 4. High Strength Threaded Fasteners: ASTM A 324
 - 5. Bearing Pads: Elastomeric or TFE to suit bearing stresses

**SECTION 03410
STRUCTURAL PRECAST CONCRETE**

- G. Grout:
 - 1. Portland cement, ASTM C 150, Type I; sand, ASTM C 404
 - 2. Nonmetallic shrinkage-resistant grout, CE CRD-C621
- H. Finish:
 - 1. Formed surfaces: Standard Finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials and system in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Provide temporary shoring and bracing as required. Roof panels shall be shored during construction, fill, and backfill activity.
- C. Tolerances: $\frac{1}{4}$ " in 20' for plumb and location. Comply with requirements of PCI MNL-127 Recommended Practice for Erection of Precast Concrete.
- D. Restore damaged units and finishes. Clean and protect work from damage.
- E. The Contractor's and Subcontractors' past performance, organization, equipment and ability to perform and complete their contracts in the manner and within the time limit specified will be elements along with the cash amount of the bid, which will be considered by the Contracting Officer in the letting of contract. The Contractor shall comply with and require all of its Subcontractors to comply with the license laws as required by the State of Utah.

END OF SECTION

PART 1 - GENERAL

1.1 **SUMMARY**

- A. Provide structural steel for building construction including sub-framing units which are part of the general framing system. Include related anchors, fasteners, and connectors.

1.2 **SUBMITTALS**

- A. Submit for approval shop drawings, product data, test reports including steel and bolt mill analysis, welder qualifications, weld inspector qualifications, fabrication shop qualifications.

1.3 **QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Standards: AISC-04, Code of Standard Practice for Steel Buildings and Bridges, and applicable regulations, AWS D1.1, latest edition, "Structural Welding Code"
- C. Testing: Independent testing laboratory
- D. Erection Tolerances: AISC standards.
- E. Steel Fabricator shall have a valid AISC Quality Certification Category 1.

PART 2 - PRODUCTS

2.1 **PRODUCTS**

- A. Steel Materials:
1. Wide flange structural shapes, ASTM A572-M Grade 345 Enhanced
 2. Other Structural Steel Shapes, Plates, and Bars: ASTM A 36-M
 3. Cold-Formed Steel Tubing: ASTM A 500, Grade B.
 4. Hot-Formed Steel Tubing: ASTM A 501.
 5. Steel Pipe: ASTM A 53, Type E or S, Grade B; or ASTM A 501.
 6. Headed Stud-Type Shear Connectors: ASTM A 108, Grade 1015 or 1020.
 7. Anchor Bolts: ASTM A 307, nonheaded type.
 8. Unfinished Threaded Fasteners: ASTM A 307, Grade A.
 9. High-Strength Threaded Fasteners: ATM A 325 or ASTM A 490, as applicable.
- B. Auxiliary Materials:
1. Electrodes for Welding: AWS Code
 2. Structural Steel Primer Paint: SSPC-Paint 1, red lead and oil
 3. Structural Steel Primer Paint: SSPC-Paint 2, red lead-iron oxide, oil alkyd.
 4. Structural Steel Primer Paint: SSPC-Paint 13
 5. Cement Grout: Portland Cement, sand.
 6. Metallic Shrinkage-Resistant Grout: Premixed ferrous aggregate grouting compound.
 7. Nonmetallic Shrinkage-Resistant Grout: Premixed nonmetallic grouting compound, CE CRD-C6

PART 3 - EXECUTION

3.1 **INSTALLATION**

- A. Comply with AISC codes and specifications, and with AWS "Structural Welding Code".

SECTION 05120
STRUCTURAL STEEL

- B. Employ a registered land surveyor to check elevations and plumb and level tolerances; certify that installed tolerances are within AISC Standards. Inspect welded and bolted connections.
- C. Architecturally exposed steel: Fabricate with special care using materials carefully selected for best appearance. Store materials off ground and keep clean. Cut, fit and assemble work with surfaces smooth, square and with complete contact at joints. Set all cambers up. Weld all work continuously; grind smooth and flush to make seams not visible after priming. Prepare surfaces to comply with SSPC-SP6; apply prime coat within 24 hours after cleaning.
- D. Touch-up field welds and abraded areas with shop primer.
- E. Welds shall be inspected by a qualified welding inspector in accordance with AWS D1.1. All field welds shall be visually inspected as a minimum. Complete penetration welds in shop or field shall be tested by ultrasonic or other appropriate non-destructive testing. The welding inspector may utilize ultrasonic or any other approved aid to assure weld quality at the inspector's discretion.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide the following:
1. Rough hardware.
 2. Miscellaneous framing and supports
 3. Miscellaneous steel trim.
 4. Steel angle.
 5. Pipe bollards.
 6. Diamond mesh for security walls

1.2 SUBMITTALS

- A. Submit for approval samples for items exposed to view, shop drawings, product data, test reports.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Handrail and Railing Structural Performance: ASTM E 985

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Ferrous Materials:
1. Steel Plates, Shapes and Bars: ASTM A 36.
 2. Steel Tubing: ASTM A 500 or A 501
 3. Uncoated Structural Steel Sheet: ASTM A 611 or A 570
 4. Uncoated Steel Sheet: ASTM A 366 or A 569
 5. Galvanized Steel Sheet, Structural Quality: ASTM A 446, Grade A, G90.
 6. Galvanized Steel Sheet, Commercial Quality: ASTM A526, G90.
 7. Steel Pipe, Black Finish: ASTM A 53.
 8. Steel Pipe, Galvanized Finish: ASTM A 53.
 9. Gray Iron Castings: ASTM A 48, Class 30.
 10. Malleable Iron Castings: ASTM A 47, Grade 32510.
 11. Reinforcing Bars: ASTM A 615, Grade 50.
 12. Brackets, Flanges and Anchors: Cast or formed metals.
 13. Concrete Inserts: Threaded or wedge type.
 14. Welding Rods and Bare Electrodes: AWS specifications.
 15. Zinc-coating: Hot-dip galvanized coating for materials in exterior assemblies or exterior walls.
 7. Security Mesh: Amico ASM.50-13F or approved equal.
- B. Stainless Steel Materials:
1. Bar Stock: ASTM A 275, Type 302 or 304.
 2. Plate: ASTM A 666, Type 302 or 304.
- C. Aluminum Materials:
1. Extruded Bars and Shapes: ASTM B 221 aluminum alloy.
 2. Rolled Thread Plate: ASTM B 632 aluminum alloy.
 3. Sheet for Expanded Aluminum Grating: ASTM B 209.
 4. Fasteners: ASTM A 153.
 5. Finish: Mill finish.

**SECTION 05500
MISCELLANEOUS METAL**

- D. Fasteners:
 - 1. Bolts and Nuts: Hexagon head type, ASTM A 307, Grade A.
 - 2. Lag Bolts: Square head, FS FF-B-561.
 - 3. Machine Screws: Cadmium plated steel, FS FF-S-02.
 - 4. Plain Washers: Round carbon steel, FS FF-W-92.
 - 5. Drilled-in Expansion Anchors: FS FF-S-325.
 - 6. Toggle Bolts: Tumble-wing type, FS FF-B-588.
 - 7. Lock Washers: Spring Type carbon steel, FS FF-W-84.
 - 8. Zinc-Coating: Fasteners in exterior assemblies or exterior walls.
- E. Auxiliary Materials:
 - 1. Nonshrink Metallic Grout: CE CRD-C621.
 - 2. Nonshrink Nonmetallic Grout: CE CRD-C621.
 - 3. Interior Anchoring Cement: Hydraulic expansion cement.
 - 4. Exterior/Interior Anchoring Cement: Erosion-resistant hydraulic expansion cement.
 - 5. Shop Primer: Alkys primer, FS TT-P-645.
 - 6. Galvanizing Repair Paint: SSPC-Paint 20.
 - 7. Bituminous Paint: Asphalt mastic, SSPC-Paint 12.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Take field measurements prior to preparation of shop drawings and fabrication. Do not delay job; allow for cutting and fitting if field measurement not practical.
- B. Form work true to lien with sharp angels and edges. Weld continuously, grind flush and make smooth on exposed surfaces.
- C. Install work plumb and level with hairline joints and ground flush welds.
- D. Touch-up damaged coating with shop primer and galvanize repair paint.
- E. Paint items scheduled in accordance with painting section.

END OF SECTION

PART 1 - GENERAL

1.1 **SUMMARY**

- A. Provide elastomeric sheet membrane waterproofing systems:
1. Igloo: Below grade concrete roof, walls and footings.

1.2 **SUBMITTALS**

- A. Submit for approval product data, warranty.

1.3 **QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Testing: Flood testing and horizontal applications.

PART 2 - PRODUCTS

2.1 **PRODUCTS**

- A. Rubberized Asphalt Sheet Waterproofing:
1. Manufacturers: W.R. Grace, W.R. Meadows, Pecora, Quaker Sealants and Coatings or approved equal.
 2. Membrane: Self-adhering rubberized asphalt and polyethylene sheet membrane, 60 mils thick, tensile strength 250 psi.
- B. Flashing Materials and Protection Board: Compatible with membrane waterproofing.

PART 3 - EXECUTION

3.1 **INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with other work.
- B. Restore damaged components and water test membrane waterproofing prior to backfill cover. Clean and protect work from damage.

END OF SECTION

PART 1 - GENERAL

1.1 **SUMMARY**

- A. Provide louvers and vents:
 - 1. Fixed metal wall louvers.
 - 2. Adjustable metal wall louvers.
 - 3. Acoustical louvers.
 - 4. Wall vents.
- B. Fusible links

1.2 **SUBMITTALS**

- A. Submit for approval shop drawings, product data.

1.3 **QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 **MATERIALS**

- A. Manufactures: Airline Products, Airolite, Construction Specialties, Industrial Louvers or approved equal.
- B. Aluminum Louvers:
 - 1. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T51, 0.81" minimum thickness.
 - 2. Blades: Horizontal drainable blades.
 - 3. Blades: Blades with integral acoustic insulation as required.
 - 4. Blade Type: Fixed or Operable (manual) as required.
 - 5. Finish: Fluoropolymer, Kunar 500 (20-year finish warranty).
- C. Louver Accessories:
 - 1. Insect Screens.
 - 2. Insulated blank-off panels
 - 3. Fixed-grill security barriers.
 - 4. Fire dampers, where required.
- D. Wall Vents:
 - 1. Material: Extruded aluminum.
 - 2. Blade Type: Fixed
 - 3. Blade Type: Adjustable
- E. Fusible Links:
 - 1. Where fusible links are installed, leave unpainted, and ensure they are serviceable, properly installed, and rated for a maximum temperature of 155 F to 165 F.
 - 2. Fusible link shall be stock number NSN 4210-00-033-6032 or suitable substitute.
 - 3. Fusible link shall be UL listed or FM approved.

**SECTION 10200
LOUVERS AND VENTS**

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with AMCA Standard 500 and provide units with AMCA Certification rating seal. Comply with SMACNA Architectural Sheet Metal Manual except as otherwise indicated.
- B. Take field measurements prior to fabrication. Install units plumb and level; isolate dissimilar materials to prevent corrosion. Touch-up damaged coatings.
- C. Provide separate continuous sills where needed to prevent water penetration. Maintain equal blade-to-blade and blade-to-frame spacing for uniform appearance. Provide concealed vertical mullions and reinforcement as needed.
- D. Provide anchors, supports and accessories as needed. Provide gaskets, flashings and fillers as necessary to make installation water tight.

END OF SECTION

SECTION 16010
ELECTRIC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL:

The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and Addenda, applicable drawings and the technical specifications herein shall apply to all work under this Division 16.

1.02 SCOPE:

- A. The work required under this Section consists of Electrical General Requirements and related items necessary to complete the work indicated within the Contract Documents.
- B. This section described procedures and incidental items of work relating to sections following under Division 16.
- C. The drawings are diagrammatic, intended to indicate the general scope and locations of the work to be installed and are not to be considered as complete in every detail. The Contractor shall install all work indicated and/or specified herein, complete to perform the function intended without additional cost.
- D. Plans and specifications are complementary, whatever is called for in either shall be as called for in both. In the event work is called for in more than one place and is of conflicting requirements, the right shall be reserved to require the installation of the larger or the more expensive.

1.03 CONTRACT DOCUMENTS:

- A. Contract documents consist of drawings, specifications, and other documents issued by the Engineer. Each is complementary and requirements shown, written or reasonably inferable therefrom on one is considered as written, shown or implied in all.
- B. Electrical drawings are diagrammatic, but shall be followed as closely as actual construction and work of other contractors will permit. Runs to panels from outlets referred to as "home runs" are indicated by pointing in the general direction of panels. Construction shall continue such circuits to the panels as though the routes were completely indicated. Home runs shall be installed from outlets as shown on drawings.
- C. Deviations from drawings required to make work of this contract conform to building as constructed, or as to work of other contractors, shall be made by the contractor at his expense. The Engineer reserves the right to make minor changes in the location of equipment and outlets without additional charges.
- D. The contractor shall familiarize himself with the architectural and mechanical plans. He shall perform all work and provide all material required by the electrical contractor shown under these and all other sections of the plans and specifications.

1.04 INFORMATION FOR CONTRACTING OFFICER:

Within fifteen (15) days after award of contract, submit the following information:

- A. Shop Drawings and Material Lists:

**SECTION 16010
ELECTRIC GENERAL REQUIREMENTS**

Six copies of shop drawings are required for materials and equipment listed in other sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these specifications. The following shall be included:

1. Front, side, and rear elevations and top view.
 2. Location of conduit entrances and access plates.
 3. Component data.
 4. Method of anchoring; weight.
 5. Finish.
 6. Nameplates.
 7. Temperature limitations, as applicable.
- B. Six copies of catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, non-custom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable specification section and paragraph, model number, and options. This information shall be marked in spaces designed for such data in the stamp. All special features required by specifications shall be noted or highlighted.
- C. Material and Equipment Schedules: The CONTRACTOR shall deliver to the Contracting Officer a complete list of all materials, equipment, apparatus, and fixtures which it proposes to use. The list shall include sizes, name and manufacturers, catalog numbers, and such other information required to identify the items.
- D. Other Information: As required by the Contracting Officer.
- E. All submittals shall include a cover letter listing each submitted item by description, manufacturer, and manufacturers catalog number.

1.05 CODES AND STANDARDS:

Perform work in accordance with best present-day installation and manufacturing practices; conform to "Manual of Accident Prevention in Construction" by the Associated General Contractors of America, Inc.

- A. Comply with all applicable laws, building and construction codes, and requirements of governmental agencies under whose jurisdiction work is being performed.

Unless specifically noted to contrary, conform with and test in accordance with applicable sections of latest revisions of the following codes and standards.

American Society for Testing and Materials (ASTM)
National Fire Protection Association, National Electrical Code (NEC)
Insulated Cable Engineers Association (ICEA)
Underwriters Laboratories Inc. (UL)
American Steel and Iron Institute, "Design Manual on Steel Electrical Raceways"
National Electrical Manufacturer's Association (NEMA)
American National Standards Institute (ANSI)
Institute of Electrical Electronic Engineers (IEEE)
Occupational Safety and Health Association (OSHA)

- B. Conflicts Between Codes and Standards and Specifications and/or Drawings: The one establishing the more stringent requirements shall be followed.

1.06 MATERIALS AND WORKMANSHIP:

**SECTION 16010
ELECTRIC GENERAL REQUIREMENTS**

All equipment and materials shall be new, of the best quality and free from defects.

- A. Each type of equipment or material shall be the same make and quality.
- B. All equipment, materials and devices shall be approved by Underwriters Laboratories, Inc. (UL). Custom designed items shall be fabricated using UL approved materials.
- C. Workmanship shall be in accordance with the best present-day construction methods and shall be neat and orderly throughout the project.

1.07 DEFECTIVE EQUIPMENT:

If equipment fails to conform to detailed specifications or to operate satisfactorily, the Contracting Officer will have the right to operate equipment until defects are corrected.

- A. The Contracting Officer will have the right to operate rejected equipment until it is replaced, without cost for depreciation use or wear.
- B. Remove equipment from operation for examination, adjustment, alteration or change only at times approved by Contracting Officer.

1.08 FINAL REVIEW AND ACCEPTANCE:

Notify the Contracting Officer when work is considered to be complete, in operating condition and ready for final review.

- A. The Contracting Officer, after determining that installation is ready for final review, will make final review and tests he deems necessary to determine that provisions of specifications are satisfied.
- B. The Contracting Officer will not accept work nor make final payment to Contractor until Contracting Engineer has certified that work of Contractor is complete and in conformance with specifications and guarantees.

1.09 RECORD DRAWINGS:

Blue line white prints of drawings will be furnished by the Contracting Officer on which this Contractor shall accurately and neatly mark in colored pencil all changes or deviations from the drawings as they are made in the work. These drawings shall be reviewed with Contracting Officer at least once a month. Failure to keep Record drawings up to date shall be cause for withholding monthly or final payment.

- A. The Contractor shall submit the Record drawings to the Contracting Officer at the final review.

1.10 COORDINATION OF CONSTRUCTION:

Coordinate work with Contracting Officer to assure orderly and expeditious progress of work. Select order of work and establish schedule of working hours for construction, subject to review by the Contracting Officer.

1.11 APPROVAL OF SUBSTITUTIONS:

**SECTION 16010
ELECTRIC GENERAL REQUIREMENTS**

Equipment and materials are designated by one or more manufacturer's name brands or numbers. It is not the intent of the specifications to exclude other equipment or materials that equal the standard of those specified. If the Bidder desires to bid on equipment or materials other than those specified, he must submit for written approval from the Contracting Officer at least seven (7) calendar days prior to bidding. Submit complete data, including detailed specifications and drawings with written request in duplicate. Samples may be requested if deemed necessary. Certificates of compliance with specifications or a list of all exceptions to the specifications shall be included with request. All submittals shall include a cover letter listing all submitted items by description, manufacturer, and manufacturers catalog number.

1.12 SITE CONDITIONS:

A. Examination Of Site: Examination of the site shall be made by the Contractor, who shall compare it with the drawings and specifications and satisfy himself as to the conditions under which the work is to be performed. He shall, at such time, ascertain and check all conditions which may affect his work. No allowance shall subsequently be made in his behalf for any extra expenses to which he may be put due to failure or neglect on his part to make such examination.

1.13 GUARANTEE/WARRANTY:

The following guarantee is a part of the specification and shall be binding on the part of the Contractor:

"The Contractor guarantees that this installation is free from defects. He agrees to replace or repair, to the satisfaction of the Contracting Officer, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance.

Electrical systems and equipment shall not be considered acceptable for substantial completion until they have performed in service continuously without malfunction for at least ten (10) days.

1.14 CLEAN-UP:

As the work progresses and on a daily basis, this Contractor shall remove from the premises and surrounding streets, alleys, etc., all rubbish and debris resulting from his operations and shall leave all equipment and material furnished by him absolutely clean and ready for use.

1.15 SUPERVISION:

A competent foreman or superintendent initially approved by the Contracting Officer, shall be at the site at all times to receive instructions and shall be empowered to act. He shall verify dimension given on the drawings and report any errors or inconsistencies to the Contracting Officer before commencing the work. The Contracting Officer, will interpret the meaning of the drawings and specifications where questions arise. Provide off-sets and alterations as required.

1.16 SAFETY REGULATIONS:

The Contractor shall furnish and place proper guards for prevention of accidents. He shall provide and maintain any other necessary construction required to secure safety of life or property, including the maintenance of sufficient lights to secure such protection.

**SECTION 16010
ELECTRIC GENERAL REQUIREMENTS**

1.17 EQUIPMENT OPERATION AND MAINTENANCE (O&M MANUALS):

- A. At the time of final inspection and before acceptance, six (6) copies of the Operating and Maintenance Manuals covering all equipment furnished under all Sections of this Division shall be furnished to the Contracting Officer. Each copy shall be neatly compiled, properly indexed and bound in a hard back ring binder. Shall contain the following information for each item of equipment:
 - 1. Operation Instructions
 - 2. Installation Instructions
 - 3. Maintenance Instructions (if any required)
 - 4. Parts Lists
 - 5. Supplier's name, address and telephone number
- B. Copies of final shop drawing submittals and all certificates, guarantees and field tests shall be included as part of these manuals.

1.18 DISPOSITION OF EXISTING EQUIPMENT REMOVED FROM SERVICE:

Existing equipment and materials such as cables, switches, conductors, etc., which are removed and not reused in the new installation shall remain the property of the Government. Contractor shall deliver such equipment to storage place as directed. Items not wanted by the Government shall be removed by the contractor.

1.19 SUMMARY

- A. All provisions of the Contract apply to this work.
- B. This specification is not intended to be used as a method of division of work among subcontractors.
- C. Work shall include all materials, appliances and apparatus not specifically mentioned herein or noted on the plans, but which are necessary to make a complete working installation. Equipment and devices furnished and installed under other Divisions of this Contract (or by Government) shall be connected under this Division.
- D. Electrical drawings are diagrammatic and not intended to show all features of work.
- E. The horsepower of motors and apparatus wattage indicated on the plans are estimated requirements. Advise Engineer of any subsequent equipment changes affecting electrical circuits.
- F. Minor changes in the location of the conduits, outlets, etc. no extra charge if directed before installation.
- G. Codes are to prevail except this shall not relieve Contractor from complying with any requirements of the plans or specifications in excess of code requirements.
- H. Purchase all code authority required electrical permits and pay fees.
- I. Abbreviations.
 - 1. Or Equal Approved by the Engineer
 - 2. Furnish Deliver to jobsite

**SECTION 16010
ELECTRIC GENERAL REQUIREMENTS**

- | | | |
|----|------------|--|
| 3. | Install | Enter permanently into the project |
| 4. | Provide | Furnish and install |
| 5. | Contractor | The company responsible for accomplishing Division 16 work |
| 6. | Government | Purchaser of Division 16 work or authorized representative |
- J. Warranty period shall be as prescribed by law as defined in Division One of this specification.
- K. All systems will be tested at completion and subsequently demonstrated to Government and Engineer. Instruction periods will be conducted by Contractor for familiarization of Government=s personnel with building systems.
- L. Record drawings will be continuously maintained in the field, subject to review by the Government and A&E team on a regular basis. At completion of the work, reproducible copies of drawings will be modified using qualified drafters to produce record drawings for delivery to Government.
- M. Provide six sets of Operations and Maintenance manuals for all electrical equipment.

PART 2 - EXECUTION

2.01 WORKMANSHIP:

- A. This Contractor shall be held solely responsible for the proper installation of his work. He shall arrange with the proper Contractors for the building in of anchors, etc., and for the leaving of required chases, openings, etc., and shall do all cutting and patching made necessary by his failure or neglect to make such arrangements with others. Any cutting or patching done by this Contractor shall be subject to the directions of the Contracting Officer and shall not be started until approval has been obtained.
- B. All cutting, welding or drilling of concrete or structural members shall be properly reinforced and patched to match as nearly as possible the surrounding work. Before cutting, welding or drilling any concrete or structural member, the Contractor shall secure the approval of the Contracting Officer.
- C. This Contractor shall assign persons in direct charge of work who are thoroughly experienced in the class of construction work specified herein. All labor shall be performed in a workmanlike manner by skilled workmen under the supervision of competent foremen.
- D. This Contractor shall periodically remove all debris and waste in order to maintain safe working and operating conditions, and shall dispose of the same in an approved manner. At the completion of work, he shall remove all his rubbish, tools, scaffolds and surplus materials from and about the site, leaving his work clean and the areas ready for occupancy.

2.02 SEISMIC RESTRAINT:

- A. All of the construction area is classified by the Uniform Building Code as Seismic Zone III. The Code requires that not only the structure, but also major mechanical and electrical components be designed and installed in a manner which will preclude damage during a seismic event. All electrical equipment shall be securely anchored and seismic braced in accordance with regulations contained in the most recent adopted edition of the UBC, and SMACNA "Guidelines for Seismic Restraints of Electrical Systems".

**SECTION 16010
ELECTRIC GENERAL REQUIREMENTS**

- B. Units mounted and secured directly to structure shall be provided with connectors of sufficient strength to meet the restraining criteria.
- C. All electrical equipment which is securely anchored (hard mounted) to the building or structure shall have supports designed to withstand lateral and vertical "G" loadings equal to or greater than UBC requirements and SMACNA guidelines.
- D. Shop drawings are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, load/deflection data, center of gravity, standard connections, manufacturer's recommendations, and behavior problems (vibration, thermal, expansion, etc.) associated with equipment so that the final design can be properly reviewed.

2.03 REPAIR OF WORK:

- A. The work shall be carefully laid out in advance and where cutting, channeling, chasing, or drilling of floors, walls partitions, ceilings or other surfaces is necessary for the proper installation, support, or anchorage of the conduit raceways or other electrical work, this work shall be carefully done, and any damage to building, piping or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Owner.
- B. Any penetrations within fire rated wall assemblies shall be appropriately repaired and replaced to full integrity of the designed fire resistance of the wall.

2.04 TESTS:

- A. On completion of the work, the installation shall be tested free from all grounds and short circuits.
- B. Normal feeders, circuits, and service entrance conductors with wire size #2 and larger shall be tested for leakage phase-to-ground and phase-to-phase prior to energization of the electrical system. The Contractor shall submit a written report to the Contracting Officer showing methods and readings taken. Voltage applied for testing shall not exceed two times normal operating voltage.

2.05 TEMPORARY ELECTRIC SERVICE FOR CONSTRUCTION:

- A. The electrical contractor doing the work will make arrangements with the Contracting Officer for the general contractor for temporary electrical service connection for construction power.
- B. Electrical contractor shall provide temporary power, complete with metering and wiring for lighting and power outlets for construction tools and equipment.
- C. Service shall be provided with a main disconnect and all 20 ampere receptacles protected by 20 amp GFI, single-pole. All temporary wiring shall meet NEC, Article 305, requirements. No attempt is made herein to specify construction power requirements for equipment in detail.
- D. At completion of project or sooner if directed, the temporary power supply shall be disconnected and removed from the construction site.

END OF SECTION 16010

KRSM 020070/71

Munitions Storage Module

Hill AFB, Utah

PART I - GENERAL

1.01 WIRING METHOD:

All wiring shall be of the following method as shown on the plans and as indicated in the Single-Line Diagram and detailed on the drawings.

- A. Insulated conductors run in conduit raceways as defined in Chapter 3 of the National Electrical Code.

1.02 APPLICABLE SECTIONS:

The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and Addenda, applicable drawings and the technical specifications herein shall apply to all work under this Division 16.

1.03 SCOPE:

Provide all operations, methods, labor and equipment and provide and install all materials and incidentals necessary for the completion of the work as specified herein or included on the drawings.

PART 2 - PRODUCTS

2.01 RACEWAYS AND FITTINGS:

A. Rigid Galvanized Steel Conduit:

1. Per USAS C80.1, zinc-coated by hot-dip galvanizing or sheradizing with additional enamel or lacquer coating.
2. Fittings shall be threaded type of same material as conduit.
3. Approved Locations: May be used in all locations except where installed underground in direct contact with earth shall have 20 mil PVC jacket or wrap with 1/2-inch overlap.

B. Intermediate Metal Conduit (IMC):

1. Per UL Standard 1242, hot-dip galvanized steel.
2. Fittings shall be threaded type of same material as conduit.
3. Approved Locations: May be used in all interior locations where not buried or in direct contact with earth.

C. Electrical Metallic Tubing (EMT):

1. Per UL "Standard for Electrical Metallic Tubing" NO. 797. Galvanized mild steel with interior coat of enamel.
2. Fittings shall be steel, double set-screw type. Cast type, indenter type or compression steel fittings are not acceptable.
3. Approved for interior locations only.
4. Not approved for exposed runs below 5'-0" above finished floor line.

**SECTION 16050
BASIC MATERIALS AND METHODS**

D. Flexible Liquid Tight Conduit:

1. Galvanized steel liquid-tight with PVC moisture and oil-proof extruded cover.
2. Fittings shall be liquid tight compression type.
3. Approved for flexible connections to equipment subject to vibration such as motors, fan, pumps, dry transformers, etc., 36-inch maximum, 18" minimum length for each connection.

E. Non-Metallic Conduit:

1. Not approved for this project. (Unless 400 hz work is required. Prior approval by contracting officer required.)

F. Aluminum Conduit:

1. Not approved for this project. (Unless 400 hz work is required. Prior approval by contracting officer required.)

G. Sizes:

1. As indicated but not smaller than 3/4-inch unless specifically noted.

2.02 CONDUCTORS: (600 Volt and below)

A. Single conductors for installation in raceways shall be as follows:

1. Size, type, location shown on drawings.
2. Standard: ICEA S-19-81.
3. Material: Soft annealed coated copper per ASTM B33 or B189.
4. Stranding:
 - a. No. 10 and smaller: Solid.
 - b. No. 8 and larger: Class B.
5. Insulation and Coverings:
 - a. Thickness: Per ICEA.
 - b. Material:
 - (i) No. 8 and Smaller: Type THHN single conductor power cable, moisture resistant, flame retardant thermoplastic insulation, 600 volt, 60 C copper temperature.
 - (ii) No. 6 and larger: Type THHN, single conductor power cable, heat and moisture resistant, flame retardant, thermoplastic insulation, 600 volt, 75 C. copper temperature.
 - (iii) All conductors shall be copper. Aluminum conductors are not approved.

2.03 SAFETY SWITCH DISCONNECTS:

- A. Provide disconnect switches where shown and required by NEC as specified herein.
- B. Type: Heavy duty, manual, single throw, fusible or non-fusible as indicated.
- C. Rating: 600 volt, ampere size as noted or as required for load served.
- D. Enclosure: Gasketed Nema 12.
- E. Fuses: Switches shall be equipped with Type "R" fuse clips factory installed. Fuses shall be dual element type RK5 of size as noted, Littlefuse indicating series.
- F. Non-Fusible Switches: For equipment 2 horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment larger than 2 horsepower, switches shall be the same as fusible type.

SECTION 16050
BASIC MATERIALS AND METHODS

2.04 JUNCTION BOXES:

- A. Junction boxes with screwed-on covers shall be sized as shown and detailed on the drawings. Any junction or pull box over 24" across shall be equipped with hinged, screw type covers for ease of cable inspection.
- B. Junction or pull boxes which are required but not shown shall be sized according to requirement of Articles 370 and 373 of NEC. Junction boxes shall not be less than 4-O, with plaster ring. Junction boxes with 4 or more conduits shall be a minimum size of 4 11/16".

2.05 WIRE DEVICES:

- A. Switches: 20 ampere, 120/277 volt, toggle type. Single pole used as designation for entire series - double pole, 3-way, 4-way or lock type. Hubbell #HBL1221. Switch and pilot shall be Hubbell #HBL1221-PL. Double pole toggle switch shall be Hubbell HBL#1222-2. Equivalent of Arrow-Hart may be used.
- B. Receptacles: 20 ampere, 125 volt, NEMA 5-20R, ivory color for locations where indicated. Hubbell HBL5362 or equivalent of Arrow-Hart.
 - 1. All devices shall be gray in color.
 - 2. Special receptacles other than those listed above shall be as designated on the drawings.
- C. Device Plates:
 - 1. For surface mounted boxes plates shall be stainless steel suitable for use on cast metal device boxes, conduit FS and FD types. Shall be complete with gaskets and approved for wet locations.
 - 2. For surface mounted or flush boxes in finished areas, plates shall be stainless steel. Gang plates shall be one-piece.

2.06 OUTLET BOXES:

- A. Boxes shall be provided in the wiring or raceway systems where ever required for pulling of wires, making connections, and mounting of devices or fixtures.
- B. Boxes in exposed conduit runs shall be cast metal conduits with threaded hubs installed exposed. Non-metallic boxes are not approved.
- C. Each box shall be metal and shall have the volume required by the National Electrical Code for the number of conductors enclosed in the box. Boxes for mounting lighting fixtures shall be not less than 4 inches octagonal or 4 inches square except that smaller boxes may be installed as required by fixture configuration, as approved. Boxes for use with raceway systems shall not be less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture outlets shall be not less than 4 inches square. Boxes in concealed conduit runs shall be equipped with tile extension rings, device mounting straps and accessories required for the purpose of the outlet.

PART 3 - EXECUTION

3.01 INSPECTION:

Examine the areas and conditions under which the work of this Section will be installed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION:

**SECTION 16050
BASIC MATERIALS AND METHODS**

- A. Coordination: Coordinate installation of electrical items with the schedules for other work, to prevent unnecessary delays in the total work.
- B. Visit the Site: The Contractor is assumed to have visited the site and thoroughly acquainted himself with conditions affecting the proposed work. No additional allowance will be granted because of lack of knowledge of such conditions. Contractor shall verify all measurements at the building and fully acquaint himself with existing conditions before beginning the work.

- C. Repair of Work: The work shall be carefully laid out in advance and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support, or anchorage of the conduit raceways or other electrical work, this work shall be carefully done and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Contracting Officer.
- D. Accuracy of Data: The data indicated on the Drawings and in these Specifications are as exact as could be secured, but their absolute accuracy is not guaranteed. Exact locations, distances, levels and other conditions will be governed by the building. Use the Drawings and these Specifications for guidance, and secure the Contracting Officer=s all changes in location.
- E. Measurements: Verify all measurements at the site. No extra compensation will be made because of differences between locations shown on the Drawings and measurements at the building.

3.03 INSTALLATION OF RACEWAYS AND FITTINGS:

- A. Concealment: Conceal all conduit in walls or ceiling space unless otherwise specifically approved by the Contracting Officer or indicated on the drawings. Where Conduit is to be exposed, install the conduit parallel with or at right angles to structural members, walls, and lines of the building, using symmetrical bends or cast metal fittings. Exposed conduit shall be painted to match.
- B. Installation:

Support conduits and boxes in an approved manner.

Expansion shields on concrete or solid masonry.
Toggle bolts on hollow masonry units.
Wood screws on wood.
Metal screws on metal.

Secure conduit with approved supports within 12" of every outlet box, junction box, gutter, panel, fitting, coupling, etc. Minimum of two supports per ten foot run. Each run shall be supported at each 90 degree bend.

Clean or replace conduits in which water or foreign matter has accumulated.

Conduit or tubing which has been deformed, rippled or crushed will not be acceptable and if installed shall be replaced.

Install insulated bushings on each end of conduit, 1" and larger. Bushings on service feeder conduits shall be grounding type. Install expansion fittings where conduit crosses building expansion joints.

Keep all conduit at least 12" away from the covering on hot water or steam pipes.

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Keep ends of conduit closed with approved conduit seals during construction of the building. Use conduit unions where union joints are required. Do not use running threads.

Except for cables or wires otherwise called for, install all conductors in conduit, metal gutter raceway or pullboxes.

Leave a non-corrosive pull line in all spare and empty conduits.

3.04 INSTALLATION OF CONDUCTORS:

- A. The number of wires in a conduit run is indicated on the Drawings by cross lines on the conduit run or as noted on single-line diagram or as scheduled. Long cross line denotes ground conductor. Where wire size is not shown, install number 12 conductors. Provide code-size conduit for number and size of wires shown or required, unless a larger conduit size is indicated on the Drawings. Minimum size raceway shall be 3/4" unless noted otherwise.
- B. Conductors shall be continuous from outlet to outlet.
- C. Make splices of conductors No. 8 and smaller with UL approved insulated steel spring wire connectors, 3M "Scotchlocks" or Ideal Industries, Inc. "Wing Nuts". Splice larger conductors with pressure type terminal lugs. Insulate and tape all splices in accordance with the governing code.
- D. Neutral conductors shall be the same size as phase conductors unless specifically noted otherwise. Provide separate neutral conductors for each circuit feeding fluorescent fixtures, dimming circuits and elsewhere as indicated or noted.
- E. Phase, neutral and ground conductors of same circuit shall be run in same conduit.
- F. Run conductors of different voltage systems in separate conduit unless specifically noted otherwise for remote control wiring of motors.
- G. Minimum size conductors shall be #12 AWG. Install larger wires, as indicated on the drawings or where necessary to limit voltage drop. Feeder conductors and power circuits to equipment shall be of the sizes indicated in the single line diagram on the drawings. Control wiring to motor starters and lighting contactors and low voltage systems may be #14 AWG. A separate ground shall be run for all feeders, multi-pole branch circuits and single phase receptacle and motor circuits.
- H. Home Runs: The drawings indicate the general direction of home runs. Continue all such home runs to the panel as though the routes were completely indicated. Route circuits at own discretion; however, circuit numbers shall be according to the drawings. On three phase, four wire systems, do not use a common neutral for more than three circuits. Do not run more than one three circuit, four wire run in any one conduit unless specifically indicated otherwise on the drawings. Connect phase conductors to breakers in panel which are attached to separate phase legs. Separate neutral two wire circuits shall be run where indicated. Oversize neutrals shall be run where indicated.
- I. Use identified neutrals and color-coded phase wires for all branch circuit wiring as follows:

	<u>120/208 Volt</u>	<u>277/480 Volt</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

**SECTION 16050
BASIC MATERIALS AND METHODS**

Larger feeder conductors shall be color coded as above by a color tag at all pull boxes, cabinets, gutters and panels.

White or grey conductors shall not be used for any conductor except neutral. Green conductor shall not be used for any conductor except ground conductor. Where other than green conductor is used for a ground, it shall be painted or taped of length in outlet, pull box, junction box and cabinet.

3.05 **INSTALLATION OF POWER EQUIPMENT:**

Provide all power and control wiring required for the work of other trades as described on the drawings and in the various sections of these specifications, except where the furnishing and installing of such wiring is specified elsewhere. Connect cord sets to Owner furnished equipment and make connections to all electric power consuming equipment whether furnished under contract or by Owner, or other Divisions.

3.06 **LABELS:**

- A. Provide labels identifying all conductors entering pull boxes and junction boxes. Identify all raceway systems where exposed and all empty outlet boxes. Label shall be on outside of cover on boxes in unfinished areas. Provide nameplates on all motor controls, switches with pilot lights, empty cabinets, time switches, and other miscellaneous devices whose function is not apparent from observation and as directed by Architect.
- B. Labels shall be engraved plastic or metal tags or plates.
- C. Nameplates shall be black laminated micarta or equal with white engraved capitol letters on black with white beveled edges.

3.07 **TESTING:**

- A. **General:** Upon completion of this portion of the work, test all parts of the electrical system in the presence of the Contracting Officer.
- B. **Test Requirements:** All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than that required by the National Electrical Code.

3.08 **FINAL REVIEW:**

- A. This contractor's job foreman shall be present at the final review of the work by the Contracting Officer.
- B. This job foreman shall have pad and pencil to list all deficient items noted. Corrections and adjustments of deficient items shall be done after the review, not during.

END OF SECTION

**SECTION 16170
GROUNDING AND BONDING**

PART I - GENERAL

1.01 **SCOPE:**

Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

- A. Grounding electrodes and conductors
- B. Equipment grounding conductors

1.02 **APPLICABLE SECTIONS:**

The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following

- A. Section 16010 - Electrical General Requirements
- B. Section 16050 - Basic Materials and Methods
- C. Section 16220 - Single Phase Pad Mounted Transformer (Oil Filled)
- D. Section 16390 - Medium Voltage (15KV) Power Distribution
- E. Section 16400 - Service and Distribution
- F. Section 16510 - Lighting Fixtures
- G. Section 16555 - Transient Voltage Suppression
- H. Section 16565 - Static Electricity Protection
- I. Section 16610 - Lighting Protection

1.03 **REFERENCES**

- A. Section 16010 - Quality Control: Requirements for references and standards.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- C. NFPA 70 - National Electrical Code.

1.04 **GROUNDING SYSTEM DESCRIPTION**

- A. Grounding Ring
- B. Metal frame of the building.
- C. Rod electrode.

**SECTION 16170
GROUNDING AND BONDING**

1.05 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms.

1.06 SUBMITTALS FOR REVIEW

- A. Section 16010 - Submittals: Procedures for submittals.
- B. Product Data: Provide for grounding electrodes and connections.
- D. All submittals shall include a cover letter that lists all items being submitted by description, manufacturer and catalog number.

1.07 SUBMITTALS FOR CLOSEOUT

- A. Section 16010 - Operation and Maintenance Data: Procedures for submittals.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.
- C. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.09 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project .

1.10 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART II - PRODUCTS

2.01 ROD ELECTRODES

- A. Material: Copper-clad steel .
- B. Diameter: 3/4 inch.
- C. Length: 10 feet.

2.02 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. T&B
 - 2. Burndy - Hi-Ground

**SECTION 16170
GROUNDING AND BONDING**

- B. Material: Irreversible Crimp Style
- C. Exothermic Weld

2.04 WIRE

- A. Material: Stranded copper.
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART III - EXECUTION

3.01 EXAMINATION

- A. Section 01039 - Coordination and Meetings: Verification of existing conditions prior to beginning work.
- B. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

- A. Section 16010 Quality Control: Manufacturer's instructions.
- B. Install rod electrodes at locations indicated.
- D. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.
- E. Provide bonding to meet Regulatory Requirements.

3.03 FIELD QUALITY CONTROL

- A. Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION 16170

SECTION 16220
SINGLE PHASE PAD MOUNTED TRANSFORMER - OIL FILLED

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. General Conditions, Supplementary General Conditions, Alternates, Addenda, Applicable Drawings and the Technical Specifications herein shall apply to all work under this section.

1.02 SCOPE

- A. Furnish and install high voltage, three phase, 60 Hz, mineral-oil immersed, self-cooled pad mounted, compartmental type distribution transformer as shown on plans and specified herein.
1. Power Transformer: Primary: 12470 volt for connection to a grounded wye distribution system. Secondary: 120/240 volt single phase pad mounted, 25 KVA, loop feed, 4 bushing, in oil current limiting fuse.

1.03 STANDARDS

- A. The equipment to be furnished shall be designed, built and tested in accordance with the latest applicable standards of IEEE, NEMA and ANSI.

1.04 FACTORY TESTING

- A. The transformer is to be given a complete series of electrical tests to assure the strictest performance to NEMA and ANSI standards. Tests should include:
1. Mechanical leak
 2. Winding Loss
 3. Excitation Current
 4. Impedance
 5. Winding Ratio
 6. Induced Voltage
 7. Polarity and phase relationship
 8. Power Factor
 9. Impulse Test
 10. High Potential Test
 11. Taps Verification
 12. Sound level
- B. Short Circuit
- C. Transformer shall be capable of withstanding short circuits in accordance with ANSI publication C57.12.00 latest revision, and ANSI publication C57.12.90 latest revision.

1.05 MANUFACTURER

- A. Approved manufacturers for transformers are General Electric, Square 'D', and Cooper Industries. Manufacturer to verify voltages prior to fabrication.

PART 2 - PRODUCTS

2.01 TRANSFORMER RATING

SECTION 16220
SINGLE PHASE PAD MOUNTED TRANSFORMER - OIL FILLED

- A. Transformers shall be dead front radial feed with two 2-1/2% full capacity taps above and below primary rated voltage. Transformer ratings shall be based on a maximum ambient not exceeding 40 degrees C and an average ambient for any twenty-four hour period not exceeding 30 degrees C. Continuous operation shall be at rated output KVA and 105% normal rated output voltage, or at zero load and 100% normal rated output voltage without exceeding designed temperature rise by resistance (assuming load power factor of 80% or higher). The transformer shall carry its continuous rating with oil and winding temperature rise by resistance that will not exceed 65 degrees C and a hotspot winding temperature rise that will not exceed 80 degrees C. The transformer shall be designed to carry short time emergency overloads in accordance with ANSI C57.92 and NEMA TR98 as applicable.

2.02 TRANSFORMER CONSTRUCTION

- A. General:
- B. Transformer shall consist of a transformer tank and a high and low voltage cable terminating compartment. The cable terminating compartment and the transformer tank shall be assembled as an integral, tamper proof and weatherproof unit for mounting on a pad. There shall be no exposed screws, bolts, or other fastening devices which are externally removable. There shall be no openings through which foreign objects such as sticks, rods, or wires might be inserted to contact live parts.
- C. Four jacking lugs shall be provided.
- D. Four lifting lugs on transformer tank.
- E. Enclosure: The high voltage transformer shall be totally enclosed. Padmounted suitable for outdoor use.
- F. Two lifting loops on tank cover.
- G. Base designed for ease of skidding or rolling in two directions.
- H. Undercoating applied to all surfaces of tank and compartment which will come in contact with concrete pad.
- I. Completely assembled.
- J. Transformer tank shall be a completely sealed unit, containing core, coil assembly and insulating liquid. Tank cover shall be welded on and shall have bolted on handhold cover for inspection and assembly shall enclose handhold cover and high voltage and low voltage cable compartments. The cover assembly shall be baffled on all sides to conceal all internal parts.
- K. High and low voltage cable terminating compartment:
 - a. Transformer shall be tamper resistant.
- L. Compartment ground connection to transformer tank.
- M. Removable bottom sill on compartment.
- N. Stainless steel hinges and hinge pins.
- O. Door stops on both doors.
- P. Stainless steel nameplate mounted on inside of low voltage door.
- Q. Two copper-faced ground pads - one each in high voltage and low voltage compartments - each having two 1/2" - 13 tapped holes on 1-3/4" centers.

2.03 MARKING:

- A. Each transformer shall be provided with stainless nameplate mounted on the inside of the low voltage door, giving the name of the manufacturer, rated KVA, frequency primary and secondary voltages, Impedance and the amount and kind of insulating liquid where used.
- B. 10" x 24" handholes.
- C. One inch pipe coupling and plugs - upper filter press.
- D. A 1/2" pipe plug above the liquid level for air test.
- E. One inch valve for combination lower filter press and complete drain, with a 3/8" sampler.
- F. The cable compartments shall be free standing enclosures which shall be detachable from the transformer tank for terminating both high voltage and low voltage cables without exposure to live parts. Lift off doors shall be provided to both compartments with low voltage compartment first. Single handle shall be provided on low voltage door with provisions for padlocking.
- G. The transformer shall be labeled with Danger-High Voltage labels inside and outside. These labels shall conform to NEMA standards Publication No. 260.

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SINGLE PHASE PAD MOUNTED TRANSFORMER - OIL FILLED

2.04 HIGH VOLTAGE TERMINATION:

- A. The high voltage termination shall be dead front, loop feed with isolation switch.
- B. The high voltage bushings shall be 15 KV class, 200 amp, bushing wells and Afeed-through@ inserts suitable for use with 15 KV class load-break elbow connectors. The un-used loop feed insert shall be non-feed-thru type and shall be capped for future use.
- C. All high voltage terminations shall be externally bolted to facilitate field replacement, and must have sufficient lead length to allow working away from the hole.

2.05 LOW VOLTAGE TERMINATION:

- A. The low voltage terminations shall be spade type terminals according to ANSI publication C57.12.26, latest revision.
- B. All low voltage terminations shall be externally bolted to facilitate field replacement and must have sufficient lead length to allow working away from hole, or these connections shall be easily accessible through a large "hand hole" in the transformer case. 6 hole spades with supports as required shall be provided.

2.06 COIL BONDING:

- A. The coils must be wound continuously without splice except for taps with a thermally activated, diamond pattern, epoxy coated paper. This process must be done carefully so that the coils are very tightly bonded.

2.07 PRESSURE RELIEF DEVICE:

- A. Each transformer shall be equipped with an automatic pressure relief device. The device shall have a flow rate of at least 50 scfm air (at 15 psig @70 degrees F), a cracking pressure of 10 psig \pm 2 psi and resealing pressure of 8 psig \pm 2 psi. The device shall have a pull ring suitable for hot stick operation.

2.08 P.C.B.'s:

- A. The transformer shall be labeled either on the nameplate or a special sticker next to the nameplate stating that at the time of manufacture, the transformer oil contained less than one part per million PCB's.

2.09 FINISH:

- A. The transformer shall be given a durable nonchalking graystone (Munsell No. 7.0 GY-3.29/1.5) outdoor finish.
- B. The transformer shall have a corrosion resistant finish that will successfully pass all of the tests contained in the latest revision of the EEI "Finishing Guidelines for Padmounted Equipment" specification.
- C. Before finishing, the metal surfaces to be finished shall be completely degreased and prepared in such a manner as to ensure maximum adhesion of the finish to the metal.
- D. Color shall be stone tan.

2.10 ACCESSORIES:

- A. Surge Arresters - Factory installed and connected to high-voltage (12470V) terminals; comply with NEMA standard LA-1. Arrestors shall be 200 amp elbow type.

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SINGLE PHASE PAD MOUNTED TRANSFORMER - OIL FILLED

- B. Drain valve with sampler.
- C. Top level oil temperature guage
- D. Oil pressure/vacuum guage.
- E. Load break switch - single, two pole - phase, load break, gang operated disconnect switch disconnecting the transformer from the incoming loop power.
- F. The transformer shall include under-oil Abayonet@ style fusing. Size fuses with AE@ speed fuses size as directed by the factory.

PART 3 - EXECUTION

3.01 **TESTING (ELECTRICAL CONTRACTOR)**

- A. Test for ground and short circuits on the primary and secondary side before energizing the transformer. Any damage resulting from such loads will be the responsibility of the Subcontractor. Confirm time of connection with the Owner 72 hours before energizing the equipment. All terminations in accordance with manufacturer recommendations.

3.02 **GUARANTEE**

- A. The manufacturer shall guarantee that the transformer furnished under this specification is of first class material and workmanship throughout, that it has tested in accordance with this specification, and that the results of the tests comply with the requirements of this specification.

END OF SECTION

SECTION 16390
MEDIUM VOLTAGE (15KV) POWER DISTRIBUTION

PART I - GENERAL

1.1 SCOPE:

A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

1. New primary feeder cables in new duct banks, and conduit from new substation metal enclosed gear to existing loop distribution system as shown on the plans and indicated in the single-line diagram in the drawings.

1.2 APPLICABLE SECTIONS:

The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following

1. Section 16010 - Electrical General Requirements
2. Section 16050 - Basic Materials and Methods
3. Section 16170 - Grounding and Bonding
4. Section 16220 - Single Phase Pad Mounted Transformer (Oil Filled)
5. Section 16400 - Service and Distribution
6. Section 16510 - Lighting Fixtures
7. Section 16555 - Transient Voltage Suppression
8. Section 16565 - Static Electricity Protection
9. Section 16610 - Lighting Protection

1.3 QUALIFICATIONS OF CABLE SPLICERS:

All terminations shall be made by qualified cable splicers. Contractor shall submit to Engineer complete qualifications and a copy of the certification certificate of each person he intends to use to do this work. Engineer must approve these qualification and cable terminations shall not be made by other than approved personnel. Qualifications of each cable splicer shall include at least four medium voltage (15 KV) projects on which he/she did the splices and terminations.

1.4 MANUFACTURER=S QUALIFICATIONS:

The cable manufacturer shall have a minimum of twenty (20) years of proven and successful experience with manufacturing of EPR insulated cables, similar to those specified, at the actual plant of manufacturer.

1. Certificate of Compliance: Cable as manufactured to meet the requirements of this specification by Okonite or equivalent of Kerrite will be acceptable for this project. Other cable manufacturers will be given consideration prior to bidding provided their request for substitution is accompanied by a letter certifying they will meet the .specification or a letter listing all the exceptions they will take to the specifications. Request for substitution shall be submitted in accordance with requirements outlined in the General Conditions and section 16010 of this specification.

1.5 SHOP DRAWINGS:

Descriptive data of cable, splicing, terminating and other equipment furnished under this

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MEDIUM VOLTAGE (15KV) POWER DISTRIBUTION**

Section shall be submitted to engineer for review before manufacture and shipment in accordance with the requirements of Section 16010 of these specifications.

1.6 APPLICABLE CODES AND STANDARDS:

A. All cables shall conform to the applicable portions of the following current standards.

1. ICEA - Insulated Cable Engineers Association
2. IEEE - Institute of Electrical and Electronic Engineers
3. NEC - 1990 National Electrical Code (NEPA 70)
4. UL - Underwriters Laboratories
5. AEIC - Association of Edison Illuminating Companies Standard CS6-96.

PART 2 - PRODUCTS

2.1 PRIMARY CABLE (SINGLE CONDUCTOR - SOLID DIELECTRIC, EPR):

A. General: This specification covers single conductor, 15,000 volt, shielded copper power cable insulated with an ozone and discharge resistant and flexible, rubber-like, thermosetting dielectric material for medium voltage applications. The cable shall be suitable for use in wet or dry locations in conduit, underground ducts, and cable trays.

B. Cable Construction:

1. The conductor shall be Class B compact strand and annealed copper covered with an extruded semi-conducting EPR strand screen, 220 mil of ethylene propylene rubber insulation material, extruded EPR semi-conducting insulation screen, with a minimum 5 mil bare copper shielding tape applied with a 12-1/2% minimum overlap, with an 80 mil PE jacket, 15KV type MV-105, 133% insulation level.
2. The conductor strand screen, insulation and insulation screen shall be extruded simultaneously (triple-tandem extrusion). Color differentiation shall be accomplished by using black semi-conducting layers and red insulation.
3. The EPR insulation must contain NO polyethylene polymer as a component. The ethylene content of the rubbers used in the insulation **MUST NOT EXCEED 72%** by weight ethylene. Both features to limit the degree of susceptibility of "treeing" experienced by highly crystalline materials. The insulation must be compounded in the cable manufacturer's own facility using a closed system to insure maximum cleanliness.
4. All cables shall have a permanent printed legend on the jacket. This identification shall be durable enough to remain legible for the design life expectancy of the cable. Each cable shall be clearly marked on the overall jacket, at a maximum of 2 foot intervals with the manufacturer's name, year date, voltage class, conductor size and a unique serial number indicating the production run or batch.
5. Ends of conductors on all shipments made shall be sealed with heat shrinkable seals at the factory.
6. All cable furnished shall be newly manufactured (no more than 12 months in storage), and shall bear a tag containing name of manufacturer, NEC designation, quality control number and year of manufacture.

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C. Factory Testing and Reporting:

1. Four copies of certified test reports shall be furnished at the time of delivery. All tests shall be per AEIC CS6-87. All portions of the AEIC qualification report shall be considered part of the test reports and shall be submitted.
2. The complete cable shall be tested for partial corona discharge and shall comply with the AEIC CS6-96 Paragraph F.2 requirements. A copy of the ORIGINAL X-Y plot showing discharge levels at the time of delivery shall be provided.
3. The Owner reserves the right to have all cable analyzed by an independent laboratory to assure compliance with the above specifications.

D. Warranty: The manufacturer shall warrant that the cable furnished under this specification is of first class material and workmanship for a period of five (5) years from the date of the certificate of substantial completion of installation, terminated and operated with in acceptable industry practices and standards. In the event the cable is found to be defective in either material or workmanship, as mutually agreed upon by the Owner and the manufacturer, the manufacturer shall agree to repair or to replace the defective length(s) of cable during the five-year warranty. This warranty shall be based upon the cable being installed and field tested in accordance with the manufacturer's procedures.

E. Packaging and Shipping Requirements: All cable to be shipped on wooden, non-returnable (N/R) reels. All reels shipped shall not be shipped laying flat. Any shipment arriving laying flat will be immediately rejected by the Engineer or Contractor and shall be the supplier's responsibility for return shipments.

2.2 GROUNDING NEUTRAL CONDUCTOR:

A. A separate type XHHW conductor shall be run in the same duct or conduit as the primary cable conductors for grounding of the 12470 volt Delta, three-phase, 3-wire primary cable system.

2.3 CABLE SPLICES AND TERMINATIONS:

A. Elbow Terminators: At pad-mount primary switches shall be 200 amp, 8.3/14.4 KV load-break terminators as indicated in the diagrams and of size required for the cable terminated. Each elbow terminator shall be complete with testpoint with insulated covers. Tape shield adapters shall be provided for each termination. Shall be cooper or equal of Elastimold. Provide Owner with installation and disconnect tools as required.

1. Surge Arresters: Type M.O.V (metal oxide varistor) over voltage surge arrester in a pre-molded rubber elbow dead-front device. Shall meet ANSI/IEEE Standard 386 15 kv class, 9.3 kv operating voltage for transformers use Elastimold 167ESA or equal. For switches use Elastimold 167BSA or equal.
2. Bushing Well Inserts: Where indicated in the diagrams on the drawings provide bushing well inserts for each cable termination. Well inserts shall be externally fastened. Provide insulated plugs for unused bushing wells and insulated protective caps for each unused stand-off insulator, bushing or well insert.
3. Stress Cone Terminators: Terminators for cable to transformer bushings and equipment in enclosures shall be Cooper Fasterm type and adapter as required for tape shielded cable, or equal of 3M or RayChem.
4. In-Line Splices: Splices to existing cables shall be done with 3M 5500 series, 15 kv cold shrink splice kits with connectors as noted on drawings. Confirm the type and

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size of existing conductors to which the splice is to be made. Installation shall be done in strict compliance with manufacturer's instructions.

5. Ground Rods: 5/8" x 8'-0" copper clad steel.

2.4 PHASE IDENTIFICATION:

- A. Each phase conductor shall be identified at each termination by a permanent plastic tag securely fastened to a cable minimum of 18" back from a tape shield adapter or stress relief cone. Phase designation shall be consistent throughout entire primary system. Phases shall also be color coded by three bands of colored tape to match existing feeder system.
- B. All conductor and cable connections shall be properly phased throughout the primary cable system in order to allow loads to be served from different directions on loop circuits.

2.05 PRIMARY SECTIONALIZING CABINET

- A. The Primary sectionalizing cabinets can be manufactured from steel with a Concast housing to support the cabinet, or Fiber glass, direct buried. The unit is to be equipped with three each 15KV, 200 amp two way junctions. The junctions to be delivered with shipping caps on the junctions. Provide insulated dead end caps on junctions that are energized. Durham No. 1007020 with Concast Base No. FC-60-18-18, or approved equal
- B. Provide a 3/4" x 8" copper clad ground rod in the cabinet and ground all enclosures, neutral conductors and ground wires with exothermic type connections.

PART 3 - EXECUTION

3.7 GENERAL

- A. All splices and terminations shall be made by qualified cable splicers in strict accordance with the recommendations, drawings and instructions of the cable manufacturer, and shall be made with approved termination kits. (See paragraph "Qualification of Cable Splicers".)
- B. Stress relief cones with tape shield adapters are required at all terminations.
- C. Ground to grounding system. All components shall be rated for 8.3/14.4 KV ground wye operation.
- D. Each junction and termination shall be complete with all appurtenances and accessories required for a complete connection.
- E. Before each splice and termination, contractor shall give the owner and Engineer 24 hours notice.

3.8 INSTALLATION OF CABLES IN DUCTS AND CONDUITS:

- A. Conduit and ducts shall be thoroughly cleaned. Contractor shall strictly adhere to manufacturer's recommendations and instructions as to pulling, bending, splicing and terminating cables.
- B. Train cables on walls of manholes as indicated. Cables shall ring each manhole as detailed in the manhole exploded views on the drawings.

3.9 GROUNDING:

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- A. At each switchgear assembly, manhole and transformer installation bond all metal frames and cases of equipment, racks, supports, etc., to ground rods and ground conductor of primary cable. Approved bronze ground clamps or cadweld connections shall be utilized. Surge arresters shall be grounded to new separate ground rods.

3.10 PRIMARY CABLE CONDUIT:

- A. Where the drawings show primary cable as being installed in metallic conduit, such conduit shall be rigid or IMC galvanized steel with threaded fittings. Conduit run underground and not encased in concrete shall have 40 mil PVC jacket or wrap. Provide 0-Z Gedney Type "BLG" insulated grounding bushings at each conduit termination in cabinets boxes and equipment. Minimum radius of conduit bend shall be 36".

3.11 CABLE LENGTHS:

- A. It is the Contractor's responsibility to determine the exact cable lengths on the job and after the duct system has been completed. Cable lengths shall be long enough to allow training of cables along walls of manholes as indicated in the details on the drawings.

3.12 FIREPROOFING OF CABLES:

- A. All new feeder cable in each new and existing manhole and vault shall be fireproofed.
- B. Fireproofing shall be done by wrapping entire length of each cable exposed in each manhole with tape specifically designed for such application as manufactured by 3M Company. Installation of tape shall be done in strict compliance with tape manufacturer's instructions and recommendations.

3.13 CABLE SUPPORTS:

- A. In those manholes indicated and elsewhere as required where cable needs support due to vertical drop in cable run, furnish and install cable support grips.

3.14 FIELD TESTS OF NEW CABLE AND TERMINATIONS:

- A. The primary cable shall be given voltage D.C. test after entire installation and terminations have been completed. The cost of the test and the test reports shall be borne by the Contractor.
- B. Tests shall be made by the Contractor in the presence of the Engineer and the Owner's Inspector and shall include circuit continuity test and high potential tests..
- C. In the event that the results obtained in the tests are not satisfactory, the Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclosed the faulty or defective work or equipment, and shall make such additional test as the Engineer deems necessary.
- D. The Electrical Tests shall include the following:
 - 1. Continuity Tests: Each circuit shall be "rung-out" or "talked-out" with proper signaling devices and with all equipment disconnected at each end to indicate that it is a continuous circuit where the operating requirements are that it shall be continuous.
 - 2. High Potential Tests of Power Cables: All primary cables shall be given d-c high potential tests after entire installation and after potheads or other terminations have been made, but before connections have been made to busses or apparatus. The cable shall be tested for 10 minutes duration at 35.0 KV DC from conductor to

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sheath or as specified by cable manufacturer.

- E. A D.C. milliammeter in series with the ground connection of the high voltage transformer shall be used to read the leakage current in the cable at one-minute intervals during the test. A variable ratio voltage regulator of adequate rating shall be used to permit the raising of test voltage at a slow but uniform rate from zero to test value. Testing time shall be started when the voltage on the cable has attained test value.
- F. If a cable fails, the fault shall be located, and cable between the nearest junction the replacement of the faulty cable, the test shall be repeated.

3.15 WARRANTY

Refer to Paragraph 2.01 of this section, the General Conditions and section 16010

END OF SECTION

SECTION 16400
SERVICE AND DISTRIBUTION SYSTEMS

PART I - GENERAL

1.01 **APPLICABLE SECTIONS:**

- A. The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and addenda, applicable drawings and the technical specifications herein shall apply to all work under this Division 16.

1.02 **SCOPE:**

- A. Provide all operations, methods, labor and equipment and provide and install all materials and incidentals necessary for the completion of the work as specified herein or included on the drawings.

1.03 **WORK INCLUDED:**

- A. Electrical work required for this work is shown on the drawings and includes, but is not necessarily limited to:
 - 1. Complete electrical distribution system for power as shown.
 - 2. Complete system of raceways and outlets for Control and all other auxiliary systems of this Division 16. Unless noted otherwise, the equipment and wiring of these auxiliary systems will be furnished and installed under their respective sections; however, the conduit raceway systems will be furnished and installed under Section 16050.
- B. Shall furnish and install all component parts of all the systems required for their safe and proper operation, whether or not specifically mentioned or noted on the drawings, except those items or articles which are specifically noted hereinafter as being supplied otherwise.
- C. Provide all required electrical connections and service to items described in all other sections of these specifications. Provide all those services outlined in other divisions of the specifications as being done by the electrical sub-contractor.

1.04 **SERVICE:**

- A. New underground secondary service from padmount transformer is 120/240 volt, single phase, three wire continuous run material (no splices), 60 hertz A.C.

PART 2 - PRODUCTS

2.01 **BRANCH CIRCUIT PANELBOARDS:**

- A. Branch circuit panelboards shall be Siemens Type S-1 for the scheduled voltage, 1 phase, 3 wire operation or equal of Square D, General Electric or Cutler Hammer. Shall be equipped with bolt-on breakers. Minimum width shall be 20 inches. Minimum depth shall be 5.75 inches. Panel trims shall be of the door within door or hinged cover construction. Panels to be weather proof NEMA 3R.
- B. Busses shall be copper.
- C. Branch circuit breakers shall be provided per schedules on drawings. All multi-pole breakers shall be common trip.
- D. Doors shall be complete with typed circuit schedule on inside.

SECTION 16400
SERVICE AND DISTRIBUTION SYSTEMS

PART 3 - EXECUTION

3.01 **TESTING:**

- A. General: Upon completion of this portion of the work, test all parts of the electrical system in the presence of the Contracting Officer.
- B. Test Requirements: All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than that required by the National Electrical Code, Article 250.

3.02 **FINAL INSPECTION:**

- A. This Division 16 contractor's job foreman shall be present at the final inspection of the work by the Owner.
 - 1. The job foreman shall have pad and pencil to list all deficient items noted. Corrections and adjustments of deficient items shall be done after the inspection, not during.
 - 2. See Section 16050 for other requirements for final inspection.

3.03 **INSTALLATION OF GROUNDING SYSTEM:**

- A. The conduit system and neutral conductor of the wiring system shall be grounded to the UFER ground having a continuous path to earth in compliance with NEC. Point of connection to the water system shall be as near as practicable to the service entrance. Provide bonding jumper same size as system ground to provide ground continuity from customer's side of metallic lines service entrance and street side of metallic mains. The neutral and ground shall be connected together at the main service switch only.
- B. The UFER ground system consists of a 500 mcm bare copper conductor concrete encased in the foundation footing of the building which is in direct contact with earth. The UFER ground will make a complete loop in the foundation and is bonded to the building steel at two locations. Make all connections to UFER ground with exothermic connections.
- C. The equipment grounding system shall be such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with the electrical circuits operate continuously at ground potential and provide a low impedance path for the possible ground fault currents. The system shall comply with the National Electrical Code, modified as indicated on the drawings or specifications and as hereinafter specified to incorporate a maximum 25 ohms ground resistance.
- D. The distributions system shall be provided with a separate equipment grounding conductor for each single or three-phase feeder, each branch circuit with a multi-pole protective device and each single phase receptacle and motor circuit as indicated. The required grounding conductor shall be installed in the common raceway with the related phase and/or neutral conductors. Single-phase branch circuits required for lighting, shall consist of phase and neutral conductors installed in common metallic conduit with green ground conductor. Flexible conduit equipment connections utilized in conjunction with the above single-phase branch circuits shall be provided with suitable bonding jumpers connected to approved grounding type bushings. Single-phase branch circuits and all branch circuits installed in flexible conduits shall be provided with a separate grounding conductors as hereinbefore specified for the multi-pole branch circuits.

SECTION 16400
SERVICE AND DISTRIBUTION SYSTEMS

END OF SECTION

PART I - GENERAL

- 1.1 The goal of any grounding system is to provide a low resistance path for fault or transient currents to the earth. "Grounding" may be described as the process of making this electrical connection to the general mass of the earth. The characteristic primarily determining the effectiveness of a grounding system is the impedance this connection provides to the earth.

The importance of ensuring that the system provides a low impedance, and not simply a low resistance, must be understood. A spectral study of the typical waveform associated with transient impulses, such as those characteristics of lightning and switching surges, reveals both high frequency and low frequency components. The high frequency is associated with the extremely fast rising "front" of the transient while the lower frequency component resides in the long "tail" of the decaying impulse.

A grounding system appears to such transient events as an impedance rather than simply a resistance. Correct interpretation of the effectiveness of this ground system requires an understanding of transmission line theory where the normal rules of wave propagation and group velocity apply. A low impedance grounding system is only achieved by considering the roles played by each of resistance, capacitance and inductance within the system.

The capacitance of the ground system dominates during the steep rising front of the impulse by providing a path to ground for these high frequency components. To assist this process, the capacitance of the ground system would be maximized. In practice this means that the surface area of contact made with the ground, must be as large as possible. The use of flat conductors instead of round, buried metal plates, earth meshes and ground enhancing materials (which effectively increase the surface contact of driven rods) are all ways of increasing the capacitance of the ground system's coupling to true earth.

The inductance of the ground system dominates during the rapid change of current with time as the current is injected into the earth. The voltage developed due to the inductive term is given by $L di/dt$. This may become dangerously large, creating the risk of flash over if attention is not paid to ensuring that the inductance is minimized in the system. Sharp bends in down conductors and bonding connections should be avoided and the use of flat conductors, instead of radial ones, encouraged.

Finally, the resistance of the contact to the earth medium is particularly important during the decaying "tail" of the surface as this is where the large energy content (Joules) of the impulse resides. A low resistance contact ensures safe dissipation of this excess energy into the ground. In practice this can be achieved by using longer driven rods, multiple rods, or by encasing rods with conductive ground enhancing materials.

In summary, an effective ground system should exhibit a low impedance rather than simply a low resistance thereby ensuring it maximizes the dissipation of both the high and low frequency components characteristic of surges and fault transients.

Grounding shall conform to applicable requirements in the National Electrical Code, the National Electrical Safety Code, UL 467, and herein. Unless specifically indicated otherwise, the following shall be grounded:

- A. Neutral conductor of the wiring system at the transformer and at the service entrances only (not at other points).
- B. Grounding conductor of nonmetallic sheathed cables and nonmetallic raceways
- C. Metallic raceways, conduits, cable sheaths, armor, and junction boxes
- D. Non-current carrying metallic parts of equipment
- E. Pot-head boxes
- F. Lightning arresters

SECTION 16450
GROUNDED

PART 2 – GROUNDING CONNECTION

- 2.1 A ground connection shall be made at the main service equipment and shall extend to the metallic water service entrance with a ground conductor. Connection at the water pipe shall be made with a suitable cast pressure type ground clamp. If flanged pipes or dielectric union are encountered at the water service entrance, the connection shall be made with a lug bolted on the supply side of the flanged connection. If there is no metallic water service to the building, the ground connection shall be made by driven rods on the exterior of the building.

PART 3 – GROUNDING CONDCUTORS

3.1 GROUNDING CONDCUTOR:

The grounding conductor shall be connected to a made electrode. The electrode shall be 100 feet of bare copper cable encased along the bottom of the concrete foundation footing of the building. The size of the bare copper cable shall be in accordance with Table 250.94 of the National electrical Code except that it shall not be smaller than number 4 AWG.

3.2 OUTLET AND RECEPTABLE GROUNDING CONDCUTOR

Provide a separate green THW insulated copper grounding conductor to grounding type outlets and receptacles.

PART 4 – GROUND RODS

4.1 GROUND RODS

The National Electric Code (NEC) states that nonferrous rods, or their equivalent, less than 5/8" diameter shall be listed. UL 467 requires that steel ground rod electrodes must be a minimum of 1/2" in diameter, 8' in length, and plated to a minimum thickness of 10 mils of copper.

A steel rod with a copper plating thickness of 10 mils can last up to 35 years (in average soil conditions) and a copper plating thickness of 13 mils (REA Standards) may last up to 45 years. Galvanized steel ground rods only have a life expectancy of 15 years.

Taking life expectancy into consideration, copper bonded ground rods are less expensive than galvanized ground rods. Just divide the purchase price by the life expectancy of each rod and you realize copper bonded ground rods are a great value.

The majority of ground rod clamps (acorns) used today are made of cast bronze (derivative of copper). This causes a dissimilar metal junction with ground rod (when the rod is galvanized material) which can accelerate the corrosion of the grounding system.

Doubling the length of a ground rod will typically decrease its ground resistance by 40% while doubling its diameter only reduces resistance by 10%.

To optimize ground rod effectiveness, multiple ground rods should be spaced at least one to two times the rod length.

A seasonal temperature change from 68 to 23-degree F (20—5 degree C) will increase soil resistivity by a factor of 10 due to freezing.

For grounding a lightning discharge, the performance of the grounding system in the frequency range of 2.5 to 25kHz is critical.

4.1 GROUND RODS:

- A. Ground rods except those installed in manhole shall be made of copper, or copper-clad steel, with a copper plating of at least 10 mils, not less than ¾ inch by 10 feet long, and shall be driven into the earth at least 11 feet. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions.
- B. If this resistance cannot be obtained with a single rod, two additional rods, shall be installed not less than 6 feet on centers, or if sectional-type rods are used, two additional sections shall be coupled and driven with the first rod. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer's representative shall be notified immediately.

4.2 MANHOLE GROUND RODS

- A. On each electric manhole, at a convenient point close to the wall, a 1 inch by 10 foot steel ground rod having a minimum coating of 13 mils of copper plating thickness, and shall be driven into the earth before the floor is poured so that approximate 4 inches of the ground rod will extend above the manhole floor. When recast concrete manholes are used the top of the ground rod may be below the floor and ground conductor brought into the manhole by means of a No. 1/0 AWG cable through a watertight sleeve in the manhole wall or floor. Connection to this ground rod shall not pose a dissimilar metal corrosion problem.

PART 5- GROUNDING METHODS

5.1 SWITCH STATION GROUNDING:

- A. Ground rods installed for the switch station shall be properly connected to the switch stands and enclosures by means of No. 4 AWG tinned and stranded copper cable or equivalent tinned braided copper conductor. Connections to ground rod shall be by means of bolted clamp remains (acorns) or approved fusion-weld-process.

5.1 MANHOLE GROUNDING.

- A. Ground rods installed for the electrical distributions system manhole shall be properly connected to neutral conductors and metallic cable sheaths and armor by means of No. 4 AWG tinned stranded copper cable or equivalent tinned braided copper conductor. The lead sheath of lead covered power cables installed in manholes and cut lines shall be grounded to a 1 inch by 10 foot long galvanized-steel ground rod having a minimum coating of 13 mils of copper plating thickness. In addition, the ground rod shall be protected 2 inches above and 6 inches below ground line with a double wrapping of pressure sensitive plastic tape. Connection to lead cable sheaths shall be by means of tinned terminals soldered to the ground cable and cable sheath and connectors not posing a dissimilar metal corrosion problem. Connection to ground rod shall be by means of bolted clamp terminals (acorns) or approved fusion weld process. Care shall be taken in soldering not to damage the lead sheath. The ground wire shall be neatly and firmly attached to the manhole wall, and the amount of exposed bare wire shall be held to a minimum.

5.2 TRANSFORMER STATION GROUNDING

- A. Transformer station grounding shall be as indicated on drawing except that ground resistance shall not exceed 25 ohms. A bare copper cable not smaller than No. 4/0 AWG shall be installed not less than 24 inches below grade connecting to the indicated ground rods. Equipment connections shall be not smaller than no. 4 AWG. Transformer neutral connections shall not be smaller than No. 1/ AWG. Where the rated secondary current exceeds 400 amperes, the size of the transformer neutral ground connection shall be increased in size to not

SECTION 16450 GROUNDED

less than one half the cross-section area of the secondary phase conductors. Where the measured ground resistance exceeds 25 ohms, additional ground rods or deep driven sectional ground rods shall be installed not less than 6 feet apart, and shall be connected by cable not smaller than no 4/0 AWG, 2 feet below grade, until a ground resistance of 25 ohms or less is obtained, except that the total length of additional ground rods required shall not exceed 50 feet. Ground conductor connections shall be made with Bundy Servits, Type KS, KSO, or KSU as applicable. Conductors shall be connected to ground rods with an approved cast bronze clamp.

5.3 BUILDING GROUNDING

- A. Ground bus and rods shall be provided in the transformer equipment room as indicated. Non current carrying metal parts of electric equipment shall be effectively grounded by connection to the bus. The ground bus shall be connected to both the system neutral water service ground, and to the ground rods. If a total resistance of 25 ohms or less is not obtained with the ground rod bus, a longer rod or additional rods shall be installed until a combined ground resistance of 25 ohms or less is obtained, except that not more than three 10-foot ground rods will be required. The distance between ground rods shall be not less than 6 feet. Ground conductors shall be copper wire, cable, or bus bar of the type and size as indicated, or as required by National Electrical Code. Ground conductors shall be installed in a neat and workmanlike manner and shall be securely held in place by means of straps placed at proper intervals. Connections and splices in the grounding system shall be made with Bundy Servits, type KS, KSO, or KSU as applicable, except where solder-type lugs are furnished on equipment (conductors shall be connected to ground rods with an approved cast bronze clamp (acom)).

5.4 LIGHTNING-ARRESTER GROUNDING CONDUCTORS

- A. Lightning arrester grounding conductor shall be separate from other grounding conductors, but may be bonded to the neutral or to the equipment ground where such ground exists within 50 feet. Ground conductors shall be not smaller than No 4 AWG for distribution-class arresters, No 1/0 AWG for intermediate-class arresters, and No 4/0 AWG for station-class arresters. Ground resistance shall not be greater than 25 ohms for distribution class arresters, 10 ohms for intermediate-class arresters, and 5 ohms for station-class arresters. Ground conductor shall be connected to a ground rod, with an approved cast bronze clamp (acorn). Ground resistance shall be measured in normally dry conditions not less than 24 hours after rainfall.
- B. Where measured ground resistance exceeds the specified value, additional ground rods or deep-driven sectional ground rods, spaced at least 6 feet apart and connected 24 inches below grade, shall be installed until the specified resistance is obtained, except that total length of additional ground rods required will not exceed 50 feet. Where an easily accessible metallic water main exists within 50 feet of the installation, ground may be connected to the water main at the option of the contractor. Ground conductor connections shall be made with Bundy Servits, type KS, KSO, or KSU as applicable

END OF SECTION

DIVISION 16000 - ELECTRICAL
SECTION 16510 -LIGHTING FIXTURES

PART I - GENERAL

1.01 SCOPE:

Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

- A Lighting fixtures: shall be as scheduled on drawings complete with all required suspension accessories, canopies, casing sockets, holders, reflectors, plaster frames, and other items and shall be completely wired and assembled. Fluorescent and high intensity discharge (HID) fixtures shall be equipped with fused ballasts.

1.02 APPLICABLE SECTIONS:

The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and addenda, applicable drawings and the technical specifications including but not limited too

- A. Section 16010 - Electrical General Requirements
- B. Section 16050 - Basic Materials and Methods

PART II - PRODUCTS

2.01 LIGHTING FIXTURES:

- A. Lighting Fixtures: Shall be as shown in the Lighting Fixture Schedule on the Drawings.
- B. Fluorescent Ballasts: All ballasts shall be electronic type as scheduled on the drawings and shall comply with the following:
 - 1. Fluorescent electronic ballasts: Shall comply with FCC rules and regulations part 18 concerning the generation of both EMI (electromagnetic interference) and RFI (radio frequency interference). Shall be Class "A" sound rated and UL class "P" thermally protected and shall be tested per ETL format. The ballast shall withstand input power line transients as defined in ANSI C62.41. The ballast shall tolerate a line voltage variation of +/-10%, shall have a power factor of 95% or higher and the lamp crest factor shall measure 1.7 or less for rapid start ballasts and 1.85 or less for instant start ballasts. The total harmonic distortion of the input current to the electronic ballast shall not exceed 20% of the input current. The ballast shall operate at 20Khz or higher and shall operate standard lamps at 0 degrees F. Ballast case temperature shall not exceed 25 degrees C rise above a 40degrees C ambient temperature. The ballast shall be provided with an internal fuse to protect the electrical power supply from internal component failure. The ballast shall also be short-circuit protected in the event of mis-wiring. Each fluorescent ballast shall be fused with Bussman type HLR fuse-holder with GLR fuse (or equivalent) connected in the phase line to the ballast and mounted within the fixture. The electronic ballast shall be warranted against defects in material and workmanship for three years. The warranty shall include either a \$15 replacement labor allowance or complete replacement including labor by an

agent of the manufacturer.

2. Ballasts shall be as manufactured by Magnetek, Advance or Motorola.
- C. Hid Fixture Ballasts: shall be high-power-factor type as manufactured by General Electric, Universal, Advance, or approved equivalent. Shall be equipped with integrally mounted primary fuse in totally enclosed fuse holder in each phase line to the ballast.
4. Lamps: shall be provided for all lighting fixtures in accordance with the lighting fixtures schedule on the drawings. Unless noted otherwise fluorescent lamps shall be full spectrum type, 5-year life expectancy. All lamps shall be new at time of final inspection and shall be manufactured by one of the following:
 1. General Electric
 2. Venture Lighting International
 3. Phillips
 4. Osram-Sylvania
- E. To provide emergency lighting when power fails to fixture, Bodine ballasts shall be provided for fixtures as scheduled and located on drawings.

PART III - EXECUTION

3.01 INSTALLATION OF LIGHTING FIXTURES:

- A. Install all lighting fixtures complete and ready for service, in accordance with the Fixture Schedule on the Drawings:
 1. Wire all fixtures with fixture wiring of at least 150 degree C rating. Conductors in wiring channels of fixtures mounted in rows shall be the same size as the circuit wiring supplying the rows.
 2. Install all fluorescent fixtures straight and true with reference to adjacent walls.
 3. Install all lighting fixtures, including those mounted in continuous rows, so that the weight of the fixture is supported either directly or indirectly by a sound and safe structural member of the building, using adequate number and type of fasteners to ensure a safe installation. Screwed fastenings and toggles through ceiling or wall material are not acceptable. Provide suitable connectors or collars to connect adjoining fixtures in continuous rows.
 4. Do not support fixtures from roof deck. Provide unistrut channels spanning space between roof joists to support fixtures and outlets.
 5. Fixtures mounted in lay-in grid ceilings shall have safety support wires to structural roof members as detailed for seismic restraint.
- B. All single outlets shall be properly centered in each room. Where two or more outlets occur, they shall be spaced uniformly and in straight lines with each other.
- C. Consult reflected ceiling plans for placement of fixtures with respect to ceiling tile patterns and equipment of other trades.

- D. Provide plaster frames and support channels around ceiling openings for recessed fixtures. Securely fasten to ceiling structural members.
- E. Terminate circuits for recessed fixtures in an extension outlet box adjacent to ceiling opening and connect to fixtures with flexible steel conduit.
- F. Where lighting fixtures and other electrical items are shown in conflict with locations and structural members and mechanical or other equipment, provide all required supports and wiring to clear the encroachment.

3.02 TESTING:

- A. GENERAL: Upon completion of this portion of the work, test all parts of the electrical system in the presence of the Architect.
- B. TEST REQUIREMENTS: All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than that required by the National Electrical Code, Article 250.

3.03 FINAL INSPECTION:

- A. This Division 16 contractor's job foreman shall be present at the final inspection of the work by the Contracting officer.
- B. Electrical job foreman shall have pad and pencil to list all deficient items noted. Corrections and adjustments of deficient items shall be done after the inspection, not during.
- C. Reference Section 16010

END OF SECTION 16510

PART I - PRODUCTS

1.1 RELATED DOCUMENTS:

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

1.2 APPLICABLE SECTIONS:

The General Conditions, Supplementary General Conditions, Alternates and Addenda, applicable drawings and the technical specification including but not limited to the following:

- A. Section 16010 – Electrical General Requirements
- B. Section 16050 – Basic Materials and Methods
- C. Section 16170 – Grounding and Bonding
- D. Section 16220 – Single Phase Pad Mounted Transformer (Oil Filled)
- E. Section 16390 – Medium Voltage (15KV) Power Distribution
- F. Section 16400 – Service and Distribution
- G. Section 16510 – Lighting Fixtures
- H. Section 16565 – Static Electricity Protection
- I. Section 16610 – Lightning Protection

1.3 SUMMARY

- A. This Section includes transient voltage surge suppressors for low-voltage circuits and equipment.
- B. Related Sections include the following:
 - 1.Division 16 Section "Wiring Devices" for devices with integral transient voltage surge suppressors.

1.4 SYSTEM DESCRIPTION

- A. Transient voltage suppression for low-voltage distribution systems, with suppressors located at each major bus, including service entrances, feeders, and branch-circuit distribution equipment.
- B. System Exposure: IEEE C62.41, low.
- C. System Exposure: IEEE C6.41, medium.
- D. System Exposure: IEEE C6.41, high

1.5 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- C. Maintenance Data: For transient voltage surge suppressors to include in the maintenance manuals specified in Division 1.
- D. Warranties: Special warranties specified in this Section

**SECTION 16555
TRANSIENT VOLTAGE SUPPRESSION**

1.6 QUALITY ASSURANCE

- A. Listing and Labeling: Provide electrically operated equipment specified in this Section that is listed and labeled.
 - 1. The Terms "Listed" and "Labeled". As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualification: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Architect not less than 2 days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions with out Architect's written permission.

1.8 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.
- B. Special Warranty: A written warranty, executed by manufacturer, agreeing to repair or replace component of transient voltage surge suppressors that fail in materials or workmanship within the specified warranty period.
 - 1. Warranty Period: 3 years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufactures: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufactures: Subject to compliance with requirements, provide products by one of the following:
 - 1. ERICO
 - 2. Atlantis Scientific Corp.
 - 3. Current Technology, Inc.
 - 4. Innovative Technology, Inc.
 - 5. LEA Dynatech, Inc.
 - 6. Northern Technologies, Inc.
 - 7. Transtector Systems, Inc.
 - 8. Wiremold Co.

2.2 TRANSIENT VOLTAGE SURGE SUPPRESORS

- A. Functional Description: Solid-state, 2-stage, transient voltage surge suppressors

SECTION 16555
TRANSIENT VOLTAGE SUPPRESSION

employing no series-connected suppression components, with Transient Discriminating technology which after a sustained over-voltage event, the unit can still be relied upon to be providing the critical equipment with transient protection.

1. Primary Suppression: Employs metal oxide varistor suppression modules.
 2. Primary Suppression: Employs silicon avalanched diode suppression modules.
 3. Secondary Suppression: Employs metal oxide varistor suppression modules.
 4. Fuses in each suppression-module circuit prevent damage to suppressor during failure of any module
- B. Overall Ratings: As indicated and as required to comply with location categories according to NEMA LS 1.
- C. Maximum Continuous Operating Voltage: At least 15 percent of nominal system operating voltage.
- D. Connection Means: Permanently wired.
- E. Protection Modes: Include the following:
1. Line-to-neutral, where applied on grounded circuits
 2. Line-to-line
 3. Line-to-ground
 4. Neutral-to-ground, where applied on grounded circuits
- F. Service Conditions: Include the following:
1. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 2. Humidity: 0 to 85 percent, no condensing
 3. Altitude: Less than 20,000 feet (6000 m) above sea level.
- G. Enclosure: NEMA 250, Type 1.
- H. Enclosure: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances, power characteristics, and other conditions affecting performance of transient voltage surge suppressors. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 CONNECTIONS

- A. Connect transient voltage suppression circuit in line-to-neutral configuration if a neutral conductor is available.
- B. Ground each transient voltage surge suppressor enclosure.
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Supervision of the field assembly of components and installation of transient voltage surge suppressors, including electrical connections, by a factory-authorized service representative. Report results in writing.

**SECTION 16555
TRANSIENT VOLTAGE SUPPRESSION**

END OF SECTION

PART 1 - APPLICATIONS

1.1 CONDITIONS

A. It is not the intent of this specification to attempt to furnish a listing of all applications where static electricity protection should be provided. The designer must analyze suspected potential static electricity charges and decide what conductive paths will be available between them, particularly in the following conditions.

1. Hazardous locations as listed in the NFPA No. 70.
2. Locations containing hazardous materials which will be handled or stored.
3. Movable and portable equipment having static electricity generating capabilities which will be dangerous to personnel.

1.2 APPLICABLE SECTIONS:

A. The General Conditions, Supplementary General Conditions, Alternates and Addenda, applicable drawings and the technical specification including but not limited to the following:

1. Section 16010 – Electrical General Requirements
2. Section 16050 – Basic Materials and Methods
3. Section 16170 – Grounding and Bonding
4. Section 16220 – Single Phase Pad Mounted Transformer (Oil Filled)
5. Section 16390 – Medium Voltage (15KV) Power Distribution
6. Section 16400 – Service and Distribution
7. Section 16510 – Lighting Fixtures
8. Section 16555 – Transient Voltage Suppression
9. Section 16610 – Lightning Protection

1.3 OTHER FACILITIES

A. Static electricity protection for other facilities will be in conformance with provisions included below, unless otherwise requested on a project-by-project basis by the using service. Where criteria of other Federal agencies conflict with criteria contained below, the most stringent criteria shall govern.

PART 2 - GENERAL

2.1 Building areas where static electricity protection is required will be identified on the contract drawings in conformance with classifications contained in NFPA No. 70. A listing of hazardous materials, containers, and operating units will be included in the design, and fixed operating equipment locations indicated on the drawings. Portable and movable equipment requiring static electricity grounding will be distinctively identified by location and with type of grounding locations required.

PART 3 – BONDING

3.1 Bonding is the process of connecting two or more conductive objects together by means of a conductor.

Bonding is done to minimize voltage differences and impedance of joints. Bonding conductors normally will be non-insulated. When bonding conductors are used between movable objects, and connections are disconnected frequently, they will be of the flexible conductor or strap type. When concealed or mechanically protected, bonding conductors may be No. 10 AWG copper wire; otherwise No. 6 AWG copper wire or larger will be used. Bonding for other facilities will conform to NFPA No. 70, and UL 467. The following guide will be used for determining objects to be bonded:

**SECTION 16565
STATIC ELECTRICITY PROTECTION**

- A. For permanently installed underground built-in equipment having metal housing and movable or portable equipment having ungrounded metal housing; bond to attached or unattached fixed adjoining metals.
- B. For movable or portable equipment normally having ungrounded metal housing located in room or area where protection of operating and maintenance personnel is required regularly; provide conductive flooring as described below.
- C. For movable or portable normally ungrounded equipment having nonconductive housing and no accessible grounding terminal; provide bonding terminal for portable type connection.
- D. For classified equipment; bond in conformance with Part 8. Electrically conductive containers with explosive and flammable contents shall be grounded. In bonding explosive and flammable contents of containers, including non-conducting liquids stored in electrically insulated containers, it may be necessary to insert a conductive electrode having a bonding terminal on the exterior of the container. The electrode material will be chemically inert to the stored ingredients and the container. Such an arrangement will be specified only by the using service. Whenever such electrode is used, it will be of a design, which will preclude its being broken off during handling of containers.

- 3.2 Before securing any bond, it is necessary to insure electrical continuity by removing any points, oil, dirt or rust to present an electrically clean contact surface.

In providing a bond for a frequently moving body such as a metal door, hinged shelf or table, not less than two separated flexible bonding straps will be provided. Bonds will not be made to gas, steam, oil, air, or hydraulic lines, nor to sprinkler system piping or metallic bodies connected to lightning protection system, except as required below finished grade, as described below.

PART 4 - GROUNDING

- 4.1 Grounding is the process of connecting one or more metallic objects and grounding conductors to a ground electrode or system. A metallic object also may be grounded-by bonding to another metallic object that is already connected to the ground. Grounding conductors within the building will be bonded separately to static electricity bonding jumpers or other bonded metals, and connected below finished grade to an appropriate grounding electrode or system. No fewer than two grounding conductors will be provided for connection to grounding electrodes at opposite corners of any building. For buildings having more than a total of 1,600 square feet or protected area, open grounding conductor electrode arrangement will be provided at each corner of the building. Steel framing members of the building and metal sides that are electrically bonded and not used for lightning protection may be as part of the grounding conductor system. Ground rods will be not less than 5/8 inch in diameter, 10 foot long copper or copper-clad rods with a minimum copper plating thickness of 10 mils, driven so the tops are not less than 6 inches below finished grade, except as otherwise required herein. The electrical power grounding system will be extended and connected to the static electricity grounding system.

PART 5 – HAZARDOUS LOCATIONS

- 5.1 Electrical design will incorporate the requirements of the using service relative to hazardous materials, equipment and containers to the extent that information is furnished to enable the construction contractor to proceed with full understanding of static electricity protection provisions. Classifications will conform to NFPA NO. 70, unless otherwise authorized by the using service. For Air Force facilities, classifications of hazardous areas of hangars, docks and POL areas will conform to AFM 88-15 (AFI 32-1065). For Army facilities, classifications for POE areas will conform to AR 415-22.

PART 6 – PETROLEUM OIL LUBRICANTS (POL) FACILITIES

- 6.1 This paragraph pertains to static electricity protection for pumping, distribution, fueling and refueling storage and miscellaneous handling facilities for Army facilities. Fueling and refueling of fixed wing aircraft on the ground is discussed in Part 10. Recommendations contained in NFPA NO. 77, will be included in each protect design of these facilities as appropriate. Prior to and during fueling of other than fixed wing aircraft, the refueling hose nozzle must be bonded to the plane by means of a short bond wire and clip, without reliance upon a separate static electricity grounding system. Air Force designs will be in accordance with the requirements of AFM 85-16.

PART 7 – WEAPONS SYSTEMS

- 7.1 Where electromagnetic pulse (EMP) or electromagnetic shielding protection is included in the design of any weapons system, grounding conductors of the static electricity protection systems, when required, will be bonded to these other protective systems at convenient locations below finished grade. Separate static electricity protection is not required for static producing units such as doors, fixed or movable equipment, electric motors, and storage containers, when these items are bonded electrically to other grounding type of protection system. When questions arises whether the static electricity generating sources may be controlled, these units will be bonded to a grounding system to assure safety to personnel and prevent real function and breakdown of weapons system tactical control functions. Weapons system support facilities provisions for static electricity protection will conform to above general requirements.

PART 8 – CLASSIFIED COMMUNICATIONS BUILDING

- 8.1 Classified communications cannot risk being compromised and endangered by permitting ungrounded static electricity discharges. Static electricity generating equipment used in classified communications operations will be bonded to a grounding system separate from other grounding systems in accordance with MIL-HDBK-419 and MIL-STD-188-124. This is required to insure complete invulnerability to intelligence countermeasures from any possible potential static electricity discharge. No fewer than two shielded grounding buses will be provided within each classified room or area. Shielded conductor to one electrode below finished grade will connect not more than two such grounding buses. Grounding buses will be arranged with a number of shielding one-wire grounding receptacles to provide a plug-in grounding jack (Telephone type) connection for each classified unit of equipment. Grounding of other than classified equipment to these grounding buses will be permitted. Ground rods will be driven into earth so that tops of connections there to shall not be less than 2 feet below finished grade.

PART 9 – CORRUGATED STEEL ARCH TYPE IGLOOS FOR STORAGE OF MB-I, GAM-87 AND GAR CASED PROPELLANT TYPE WEAPONS.

- 9.1 Static electricity grounding of case will be bonded to the lightning protection grounding electrodes. This arrangement will permit no space between cased weapons and storage racks for possibility of any static spark.

PART 10 – AIRPLANE PARKING APRONS

- 10.1 Static electricity grounding in new construction for airplane parking hydrant-refueling areas will be accomplished with a closed metal tie-down ring, 1-1/2 inches inside diameter, welded to the reinforcing steel in the concrete. Parking apron will be provided with a recess cavity at each ground rod location, permitting top of tie-down ring to become set below apron surface. The recessed cavity will be wide enough to permit static grounding temporary connections to metal tie-down ring. Resistance to ground of each tie down ring connected to the reinforcing steel can be anticipated to be less than 10,000 ohms. In hydrant refueling areas one static grounding tie-down ring will be installed between each refueling hydrant and electrical cable control box. Tie-down ring

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grounding electrode interconnections between hydrant and cable housing will not be required.
Static grounds are not designed for aircraft lightning protection.

PART 11 – AIRPLANE HANGAR FLOORS

- 11.1 Grounding devices installed in floors are intended to serve for airplane static and equipment grounding. A static grounding system conforming to NFPA NO. 77 is suitable for dissipation of any aircraft static electricity to ground. However, inasmuch as NFPA NO. 70 requires a maximum of 25 ohms resistance to ground for equipment grounding, the 25-ohms requirement will govern for this dual-purpose grounding system. Floor grounding systems electrodes will be interconnected below concrete, and interconnection also will be made to hangar electrical service grounding system. Interconnections will be of not less than No. 4 AWG bare copper. Each floor receptacle will consist essentially of a housing, grounding connection stud, housing cover and ground rod. Floor layouts for receptacles will be essentially as follows:
- A. Where hangars will be used for a specific number and type of aircraft, open grounding electrode will be provided for each aircraft space approximately 10 feet from the centerline of the aircraft space in vicinity of one of the main landing gears.
 - B. For general-purpose hangars, electrodes will be provided for each aircraft space approximately 10 feet from centerline of the aircraft space, and will be installed at 50-foot intervals. Space of electrodes from wall lines or columns will not exceed 50 feet.

PART 12 – CONDUCTIVE FLOORING

- 12.1 Where conductive flooring is provided in an area of a room, it is not necessary to provide separate grounds for metal frames of non-electric equipment located on that flooring. Conductive floors are provided essentially to protect operating and maintenance personnel from hazards of shock where personnel may otherwise become exposed to low resistance to ground (less than 25,000 ohms), at voltages of electrical distributions system, or other hazardous area system. The following guide may be used in identifying hazardous conditions and materials requiring conductive flooring for protection of personnel from static electricity:
- A. Areas containing units of operating equipment hazardous to operating and maintenance personnel.
 - B. Hazardous materials including the following:
 - a. Loose unpacked ammunition with electric primers.
 - b. Exposed Electro-explosive devices such as: squibs, detonators, etc.
 - c. Electrically initiated items with exposed electric circuits such as rockets.
 - d. Hazardous materials that could be easily ignited or detonated by a static spark such as-
 - Lead styphnate
 - Lead azide,
 - Mercury fulminate
 - Potassium chlorate-lead styphante mixtures
 - Grade B magnesium powders
 - Black powder dust in exposed layers
 - Ethyl ether
 - Ethyl alcohol
 - Ethyl acetate
 - Tetrazene
 - Diazodinitrophanal
 - Igniter composition
 - Acetone
 - Dust of solid propellants, uncased
 - Gasoline
 - Dust-air mixtures of ammonium picrate, tetryl, and tetrytel

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Anesthetics

- C. Storage areas containing exposed explosives, such as-
 - Primers
 - Igniters
 - Initiators
 - Tracers
 - Incendiary mixtures
 - Detonators

Information in connection with specific hazardous materials as listed above and units of hazardous equipment will be obtained from the using service for each project. Hazards of dust-air or flammable vapor-air mixtures can be reduced substantially by providing for adequate housekeeping, dust collection, ventilation, or solvent recovery methods.

**SECTION 16610
LIGHTNING PROTECTION**

DIVISION 16000 - ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.
- B. The following standards shall form a part of this specification; NFPA 70, NFPA 780, MIL-HDBK-419, and DOD 6055.9, AFI 32-1065, LPI-175 and UL 96A.

1.2 APPLICABLE SECTIONS:

The General Conditions, Supplementary General Conditions, Alternates and Addenda, applicable drawings and the technical specification including but not limited to the following:

- A. Section 16010 – Electrical General Requirements
- B. Section 16050 – Basic Materials and Methods
- C. Section 16170 – Grounding and Bonding
- D. Section 16220 – Single Phase Pad Mounted Transformer (Oil Filled)
- E. Section 16390 – Medium Voltage (15KV) Power Distribution
- F. Section 16400 – Service and Distribution
- G. Section 16510 – Lighting Fixtures
- H. Section 16555 – Transient Voltage Suppression
- I. Section 16565 – Static Electricity Protection

1.3 SCOPE

- A. This Section includes lightning protection for buildings and associated structures and requirements for lightning protection system components.
- B. The work covered by this section of the specifications consists of furnishing all materials, labor, and items for service required for the completion of a functional lightning protection system as approved by the Project Engineer, and in strict accordance with this section of the specifications and the applicable contract drawings. Provide a complete lightning protection system as shown on the drawings and as specified herein. The system shall be installed by a firm actively engaged in the installation of Master Labeled lightning protection systems and shall be so listed by the Lightning Protection Institute and by Underwriters Laboratories, Inc.
- C. If any departure from the contract drawings or submittal drawings covered below are deemed necessary by the Contractor, details of such departures and reasons therefore shall be submitted as soon as practicable to the Project Engineer for approval. No such departures shall be made without the prior written approval of the Project Engineer.

1.4 SYSTEM DESCRIPTION

- A. Protect entire building.
- B. Protect indicated trees.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each component specified. Include the following:

KRSM 020070/71
Utah

Munitions Storage Module

Hill AFB,

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- a. Roof adhesive data
- b. Decorative air terminal illustrations.
- C. Complete shop drawings detailing lightning protection system, the type, size, and locations for all equipment, grounds, and cable routings, etc., shall be submitted other Project Manager for approval prior to start of work. Include air terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway and data on how concealment requirements will be met.
- D. Samples and pertinent catalog data shall be submitted to the Project Engineer for approval.
- E. Qualifications data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include data on listing or certification by nationally recognized testing laboratory (NRTL) or trade association. Include lists of completed projects with project names and addresses, name and addresses of architects and owners, and other information specified.
- F. Certification, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the single-ply membrane roofing material.
- G. Field inspection reports indicating compliance with specified requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is NRTL listed or who is certified by the Lightning Protection Institute as a Master Installer/Designer.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - a. The terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - b. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Provide UL Master Label
- D. Provide LPI certification of system
- E. Provide ETL Master Label indicating system complies with specified requirements
- F. The lightning protection system shall conform to the requirements of the UL, NFPA and DOD Standards for Lightning Protection Systems (LPS).
- G. The system to be furnished under this specification shall be standard product of a manufacturer regularly engaged in the protection of lightning protection systems and shall be the manufacturer's latest approved design. The equipment manufacturer shall also be UL listed and approved manufacturer and a fully certified manufacturer member in good standing of the Lightning protection institute. All materials shall be supplied by an LPI approved supplier, such as VFC, Inc., 1409 South 500 West, Unit A, Woods Cross, Utah 84087, or Harger Lightning & Grounding 301 Ziegler Drive, Grayslake, IL 60030. For approval of LPI manufacturer other than specified, proposed material data and installation drawings shall be submitted for review and approval not less than 10 days prior to bid.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Submit to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- B. Manufacturers: Submit to compliance with requirements, provide products by one of the following:

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- a. EIRCO, Inc.
- b. VFC, Inc.
- c. Harger Lightning and Grounding
- d. Thompson Lightning Protection Co.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. All equipment used in this installation shall be factory inspected, approval and properly labeled in accordance with UL requirements.
- B. All equipment shall be new, the product of a single manufacturer as outlined above, and of a design and construction to suit the application where it is to be used in accordance with accepted industry standards and UL and NFPA Code requirements for Class I Structures and as per manufacturer recommendations. Generally, all materials shall be of copper and/or copper-bronze. In locations where system components are mounted on aluminum surfaces, aluminum materials shall be used to avoid electrolytic coordination of the dissimilar metals.
- C. Comply with UL 96.
- D. All materials shall be copper or copper alloy and of the size, weight, and construction to suite the application where used in accordance with UL and NFPA Code requirements for Class I Structures and as per manufacturer recommendations.
- E. Conductors shall be copper, of 32 strands, 170gauge minimum, VFC catalog #32, or approved equal, or as specified on the drawings.
- F. Air terminal shall be solid, round copper bar of a minimum of 3/8" x 12", VFC catalog #61, or approved equal and shall projects 10" minimum above the object to be protected. Locate and space according to UL and NFPA requirement, use aluminum points of the same size only when required for corrosion prevention.
- G. Air terminal bases shall be of cat bronze with bolt pressure cable connections and shall be securely mounted with stainless steel screws or bolts. Crimp type connectors are not acceptable. VFC catalog numbers 153, 150, 154, etc., or approved equal, as required.
- H. Ground rods shall be a minimum 5/8" in diameter and 10'-0" long and shall be made of copper, or copper clad steel, with a minimum copper plating thickness of 10 mils. VFC catalog umber 5810, or approved equal. They shall be connected to the system by Cadweld exothermic weld process or approved equal.
- I. Cable fasteners shall be substantial in construction, electrolytically compatible with conductors and mounting surface and shall be spaced according to LPI and NFPA Code requirements. VFC catalog numbers 251, 262 or approved equal. When using adhesive supports, adhesive must be compatible with roof material, and shall be approved by roofing manufacturer prior to installation.
- J. Bonding devices, cable splicers and miscellaneous connectors shall be by Cadweld exothermic weld process or of cast bronze with bolt connections to cable. Cast or stamped crimp fittings are not acceptable. Splicers similar to VFC Catalog numbers 204, 208, etc., bonding devices similar to VFC catalog numbers 216, 213, 234, 235, etc., or approved equal.
- K. Equipment on stacks and chimneys shall be protected from corrosion and sized in accordance with UL and NFPA requirement.
- L. All miscellaneous bolts nuts and screws shall be brass, bronze, or stainless steel.
- M. All TVSS equipment shall comply with Section (s) 16555, and 16671.
- N. All static electricity protection shall comply with Section 16565

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine surfaces, areas, and conditions, with Installer present, for compliance with
KRSM 020070/71 Munitions Storage Module Hill AFB,
Utah

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installation tolerances and other conditions affecting performance of lightning protection.
Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. An experienced installer who is a Certified Master Installer/Designer of the LPI or working under the direct supervision of an LPI manufacturer as listed above or his authorized LIP Certified Master Installer representative shall accomplish the installation.
- B. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof involving all air terminals, splices and bond with cable downloads routed concealed either directly in the building construction or in conduit to ground. All materials shall be sized in accordance with the material requirements of NFPA 780 and UL96A. Class I Materials shall be used for systems on structures not exceeding 75 feet in height and Class II materials shall be used for systems on structures exceeding 75 feet above grade.
- C. Download cables shall be brought down concealed within the exterior walls of the structure.
- D. Copper equipment shall not be connected to aluminum surfaces except by means of an UL approved bimetal transition fitting.
- E. Install lightning protection as indicated, according to manufacturer's written instructions.
- F. Comply with UL 96A, LPI-175, and NFPA 780.
- G. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops. Where indicated, run conductors in nonmetallic raceway, Schedule 40, minimum.
- H. Conceal system conductors.
- I. Conceal down conductors.
- J. Conceal interior conductors.
- K. Conceal conductors from normal view from exterior location at grade within 200 feet (60 m) of building.
- L. Provide notification to the Project Manager, at least 48 hours before concealing lightning protection components.
- M. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components except those above single-ply membrane roofing.
- N. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's installation instructions.
- O. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.
- P. Bond ground terminals to counterpoise conductor.
- Q. Bond grounded metal bodies on building within 12 feet (4 m) of ground to counterpoise conductor.
- R. Bond grounded metal bodies on building within 12 feet (4 m) of roof to counterpoise conductor.
- S. Bond grounded metal bodies on building with 12 feet (4 m) of roof to interconnecting loop at eave level or above.
- T. Bond lightning protection components to grounded metal bodies on building at every 60 feet (18 m) with intermediate-level interconnection loop conductors.
- U. Install ground test wells.
- V. Install facility counterpoise, utilizing #6 bare copper wire, 36 inches from the facilities.
- W. Install TVSS equipment as per Section 16555 and 16671.
- X. Install static electricity equipment as per Section 16565.

3.3 SELECTED ITEM DETAIL

- A. Air Terminals: Shall be provided so as to enclose the entire building (facility) within a zone of protection. Air terminals shall project a minimum of ten inches above the area protected and shall be located at intervals not exceeding 20'-0" along ridges and around the perimeter

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of flat or gently sloping roofs (or as otherwise specified herein or on the drawings). Flat or gently sloping roofs exceeding 50'-0" in width shall be protected with additional air terminals located at intervals not exceeding 50'-0" in the flat or gently sloping area (or as otherwise specified herein or on the drawings). Air terminals shall be located within two feet of roof edges and outside corners of protected areas (or as otherwise specified herein or on the drawings). Air terminal spacing exceeding these dimensions is permitted so long as the area protected lies within a zone of protection (unless otherwise specified herein or on the drawings).

- B. Air terminals shall be installed for stacks, flues, mechanical equipment, and other objects not located within a zone of protection. Non-metallic objects or metal objects having a metal thickness of less than 3/16" requires the installation of air terminals and require conductors. Objects having a metal thickness 3/16" or greater shall be connected to the lightning protection system per code requirements using main size conductor and connector fittings having square inches of surface contact area. Air terminal mounting bases shall be of cast construction and securely fastened to the structure in accordance with code requires.
- C. Conductors: Main conductors shall be sized in accordance with the material requirements above and shall provide a two-way path from each air terminal horizontally or downward to connections with ground terminals. Conductors shall be free of excessive splices and sharp bends. No bend of a conductor shall from an included angle of less than 90 degrees nor have a radius bend of less than 8 inches. Conductors shall be secured to the structure at intervals not exceeding 3'-0".

Down conductors shall be copper and shall be concealed in the exterior wall construction if possible. Concealed conductors shall be in conduit. Down conductors shall be spaced at intervals averaging not more than 100 feet around the perimeter of the structure. In no case shall a structure have fewer than two down conductors.

In the case of the structural steel frame construction, down conductors may be omitted and roof conductor shall be connected to the structural steel frame at intervals averaging not more than 100 feet around the perimeter of the structure. Connections to the steel frame shall be made with bonding plates having 8 square inches of contact or by exothermic weld connections.

- D. Roof penetrations; Required for down conductors or for connections to structural steel framework shall be made using thru-roof assemblies with solid bars and appropriate roof flashing. Conductors shall not pass directly through the roof. Roof flashing compatible with the roofing system shall be furnished and installed by the roofing contractor.
- E. Equipotential Grounding (Common Grounding): Of all ground mediums within the building shall be ensured by the interconnecting with the main size conductors and fittings.
- F. Ground terminations: Shall be provided for each down conductor and shall consist of a 5/8" x 10'-0" (minimum) copper-clad ground rod. The down conductor shall be connected to the ground rod using a bronze ground rod clamp having at least 1-1/2" of contact between the rod and the conductor, measured parallel to the axis of the rod, or by an exothermic weld connections. Ground rods shall be located 2 feet below grade, preferably 2 feet from the foundation wall and shall extend a minimum of 10 feet vertically in to the earth. These rods shall be ground test wells so the ground resistance can be tested.

Where the structural steel framework is utilized as main conductors for the system, perimeter columns shall be grounded at intervals averaging not more than 60 feet apart. Columns shall be grounded using bonding plates having 8 square inches of surface contact are by exothermic welder connections. Conductors from the grounded connections to the ground termination shall be Class II copper lightning conductors.

All ground terminations shall be connected by a ground counterpoise as shown on the drawings.

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3.4 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture, unless moisture is permanently excluded from the junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.5 FIELD QUALITY CONTROL

- A. Periodic Inspections: Provide the services of a qualified inspector to perform periodic inspections during construction and at its completion, according to LPI-177.
- B. UL Inspection: Apply for inspection by UL as required for UL master labeling of system.
- C. ETL Inspection: Provide the services of ETL to inspect completed system for conformance with specified requirements.

3.6 COORDINATION

- A. The lightning protection installer shall work with other trades to insure a correct, neat and unobtrusive installation.
- B. It shall be responsibility of the lightning protection installer to assure a sound bond to the main water service and to assure interconnection with other building ground systems, including both telephone and electrical. Proper arresters shall be installed on the power and telephone service by either the utility or the electrical contractor as applicable.

3.7 COMPLETION

- A. Upon completion of the installation, the contractor shall furnish the Master Label issued by Underwriters Laboratories, Inc., for the system and present it to the Master Label issued by Underwriters Laboratories, Inc., for the system and present it to the Project Engineer, for the owner. If the protected structure (Facility) is an addition to or is attached to an existing structure that does not have a lightning protection systems, the contractor shall certify that the system installed complies with UL requirements and those set forth in this Section and advise the Project manager of the lightning protection work required on the existing structure to obtain the Master Label. If the existing structure does have a lightning protection system, the contractor shall advise the project manger of any additional work required on the existing system to bring it into compliance with current UL requirements and thus qualify for the Reconditioned Master Label of Underwriters Laboratories, Inc.
- B. The contractor shall also submit 1 copy of the as-built shop drawings.

END OF SECTION 16610