UNITED STATES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LANGLEY RESEARCH CENTER

HAMPTON, VIRGINIA

SPECIFICATIONS

FOR

REHABILITATION OF BUILDING 1247H

FOR THE

2 FOOT BY 3 FOOT LOW SPEED TUNNEL

LOCATED IN

WEST AREA

LANGLEY RESEARCH CENTER, HAMPTON, VIRGINIA

SPECIFICATION NO. 1-036-RFU.3808 DATE: 6-14-02

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SECTION 01010

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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under these specifications consists of rehabilitation to the 2 foot by 3 foot Low Speed Tunnel Complex at Building 1247H, West Area, of the Langley Research Center.

The Contractor shall furnish all plant, equipment, tools, materials, labor and services necessary for or incidental to a complete and finished job as shown on the drawings listed below and as specified herein.

The work to be performed includes, but is not limited to, the following:

BASE BID

Demolition:

Removal of Mach 20 Helium Tunnel
Removal of mechanical equipment, piping, and electrical work associated with the Mach 20 Helium Tunnel
Removal of flooring and mastic material containing asbestos
Removal of concrete block control room
Removal of acoustical ceiling
Removal of wall partitions
Removal of miscellaneous mechanical and electrical items
Removal of ductwork and steam distribution piping

Relocation:

Modification and relocation of 2 Ft. X 3 Ft. Low Speed Tunnel

Architectural:

Masonry walls
Hollow metal doors and frames
Acoustical ceilings
Floor coverings
Raised access flooring
Resinous flooring
Painting new and existing surfaces
Modifications to existing interior walls and doors

Mechanical:

Roof-top air conditioning units
Unit heaters
New ductwork
Fire protection modifications

Electrical:

Power connections for mechanical and new lighting systems

Modifications and extension to existing fire alarm system

ADDITIVE BID

Replacement of existing built-up roof, Building 1247H

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, Submittals:

SD-18 Records

Government-Furnished Property (GFP) Non Conformance Report

1.3 DRAWINGS

After contract award, ten sets of full size contract drawings will be furnished to the Contractor without charge.

1.3.1 Contract Drawings

The work shall conform to these specifications and the drawings listed below:

DRAWING NO.	REV.	SHEET NO.	TITLE	LATEST DATE
General				
261021	-	T1	Title Sheet	6-20-02
Demolition				
261022	-	D1	Mach 20 Helium Tunnel Outside Demolition Plan	6-20-02
261023	-	D2	1st Floor and Basement Demolition Plans	6-20-02
261024	-	D3	1st Floor Demolition Elevation	6-20-02
261025	-	D4	Valves 3400J and 3401J Existing Schematic Diagrams	6-20-02
261026	-	D5	Valves 3400J and 3401J Existing Wiring Diagrams	6-20-02
Architectural				
261027	-	A1	Demolition Plans and Section	6-20-02
261028	-	A2	Alteration Plan and Sections	6-20-02
261029	-	A3	Enlarged Control Room & Reflected Ceiling Floor Plans	6-20-02 6-20-02
261030	-	A4	Door and Finish Schedules	6-20-02
Relocation				
261031	-	A5	Tunnel Disassembly - Exploded View	6-20-02
261032	-	A6	Tunnel Configuration Plan - Sections - Details	6-20-02
Mechanical				
1104515	-	M1	Demolition Floor Plan and Roof	6-20-02

DRAWING NO.	REV.	SHEET NO.	TITLE	LATEST DATE
			Alteration Plan	
1104516	-	M2	First Floor New Ductwork Plan	6-20-02
1104517	-	M3	Schedules and Details	6-20-02
1104518	-	M4	Sequence of Controls	6-20-02
1104519	-	M5	First Floor Fire Protection Plan	6-20-02

Electrical

762170	-	E1	Power Demolition Plan	6-20-02
762171	-	E2	Lighting Demolition Plan	6-20-02
762172	-	E3	New Work Lighting Plan	6-20-02
762173	-	E4	New Work Power Plan	6-20-02
762174	-	E5	New Communication and Fire Alarm Plans	
762175	-	E6	Existing and New One-Line Diagrams	6-20-02
762176	-	E7	Panel and Light Fixture Schedules	6-20-02
762177	-	E8	Valves 3400J and 3401J New Schematic Diagrams	6-20-02
762178	-	E9	Valves 3400J and 3401J New Wiring Diagrams	6-20-02

ADDITIVE BID

1239592	-	A7	Roof Replacement and Details	6-20-02

1.3.2 Reference Drawings

The following drawings are provided for information only, to assist the Contractor in performance of the requirements of these specifications:

DRAWING NO.	REV.	TITLE	LATEST DATE
500870	A	Mach 10 & Mach 20 Location & Installation Plan	3-19-62
500873	C	Entrance Pipe Details and Assembly Mach 20	10-5-62
500887	A	Mach 20 Nozzle Assembly	3-22-62
500902	A	Test Section Mach 20 Main Assembly	3-23-62
500916	C	Mach-20 Diffuser, Assembly & Details	1-7-63
500948	A	General Assembly-Schlieren System-Mach-10 & Mach-20	3-24-62
500963	-	Helium Facility Wall Closure Mach 10 & 20	2-23-62
502182	A	Mach 10 & 20 Jet Sys Components Dwn Str of Isolation	7-23-62
511426	-	Valves Hypersonic Aerothermal Dynamics Fac	9-23-65
650321	H	Mach 20 Helium Tunnels Valve Control System Wiring Diagram Panel 14	7-26-93
650327	F	Mach 10 and 20 Helium Tunnels Valve Control System Wiring Diagram MCC 3 & 5	12-26-84
660644	E	Wiring - Back of Panel 6 106 Control Room	7-20-92
660646	G	Interconnection - Room 106B Control Console	8-31-98
701405	F	Pressure and Model Control Systems - Trench EOP - Loc. Plan	4-26-66
702016	-	High Pressure Helium Piping System	9-17-62
702019	-	Piping Details	9-17-62
702020	A	6" Takeoff Assembly & Details	1-15-63
702441	A	6" Vacuum Line & Auxiliary Vacuum Pump	1-15-63

DRAWING NO.	REV.	TITLE	LATEST DATE
		Plan & Details	
740112	D	High Reynolds Tunnel Complex Helium Bottle	6-21-61
740113	R	High Reynolds Tunnel Complex Helium Bottle	8-23-64
943526	A	Helium Valve 8 in. S602 DD OS & Y With SM-A Limitorque & Limits Switches	3-6-90

1.4 LOCATION OF WORK

The work to be done under these specifications is located in the West Area of Langley Research Center, as indicated on Contract Drawing 261021.

1.5 SCHEDULE

1.5 General Schedule Requirements

The Contractor shall commence work within ten (10) calendar days after date of receipt of Notice to Proceed. All work as required by these specifications shall be completed within 270 consecutive calendar days after date of receipt of Notice to Proceed.

1.5.2 Special Work Scheduling Requirements

The Contractor shall notify the Contracting Officer at least two weeks prior to shutting down the facility.

All equipment and materials required for a complete installation shall be on-site prior to beginning any work which requires a facility shutdown period.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01011

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PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01011

GENERAL AND ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

This section covers Langley Research Center's unique general and administrative requirements.

1.2 TEXT REFERRAL TO CONTRACTING OFFICER

All references to the Contracting Officer contained in this specification, or any severable part thereof, shall be determined to mean the Contracting Officer or the Contracting Officer's Technical Representative. If any question arises concerning the "authorization" status of a Contracting Officer Technical Representative, the Contractor shall immediately refer the question, in writing, to the Contracting Officer.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, Submittals:

SD-04 Drawings

As-Built Drawings

SD-08 Statements

Materials and Equipment Substitutions

Application for Making Connection to Utilities

Utility Outage Requests

Plumbing Worker's Qualifications

Electrical Worker's Qualifications

Mechanical Worker's Qualifications

SD-18 Records

Invoices

Contractor Release Form

Price Breakdown for Modification Proposals

Price Breakdown for Progress Payments

Order Status Reports

Schedule of Construction

Monthly Progress Schedules

Monthly Technical Progress Narrative

Certified Payrolls

Government-Furnished Property (GFP) Non Conformance Report

SD-19 Operation and Maintenance Manuals

1.4 PRECONSTRUCTION CONFERENCE

The Contractor shall attend a preconstruction conference scheduled by the Contracting Officer. Work on-site shall not commence prior to the conference. Subcontractor representatives may attend.

Discussion will address project orientation; key points of contact; safety issues; permits; the on-site location of the Contractor's office, if any, and other pertinent issues. The Contractor shall be prepared to review and discuss the specifications and drawings with the Government to resolve any post award questions prior to construction start.

1.5 PROJECT MEETINGS

The Contractor shall attend bi-weekly project meetings scheduled by the Government. Subcontractor representatives may attend.

1.6 SECURITY REQUIREMENTS AND REGULATION OBSERVANCE

1.6.1 References

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

LAPD 1600.3	(March 2000) Langley Research Security Policy
LAPD 1600.4	(August 1999) Firearms and Dangerous Weapons Policy
LAPD 1600.5	(August 1999) Workplace Violence and Threatening Behavior
LAPD 1700.7	(March 2001) Traffic Management
LAPD 1700.8	(June 1999) Parking Regulations
NPG 1371.2	(April 1999) Procedures and Guidelines for Processing Request for Access to NASA by Foreign Nationals or Representatives

1.6.2 Identification Badges

At all times while on LaRC property, the Contractor shall require its employees, subcontractors and agents to wear badges which will be issued by the NASA Contract Badge and Pass Office, located at 1 Langley Boulevard (Building No. 1228). Badges shall be issued only between the hours of 6:30 a.m. and 3:30 p.m., Monday through Friday. Temporary ID badges will be

issued upon submission of a completed Langley Form 227, "Construction/Contractor Contractors Badge and/or Vehicle Permit Request". The Contractor will be held accountable for these badges and may be required to validate outstanding badges with the NASA LaRC Security Office. Immediately after employee termination or contract completion, badges shall be returned to the NASA Contract Badge and Pass Office.

1.6.3 Contractor Regulation Observance

In performance of that part of the contract work which may be performed at Langley Research Center or other Government installation, the Contractor shall require its employees to observe the rules and regulations as prescribed by the authorities at Langley Research Center or other installation, including all applicable Federal, NASA and Langley or other local installation safety, health, environmental and security regulations.

1.6.4 Foreign Nationals Employee Access Requirements

Foreign nationals must meet the eligibility requirements outlined in NPG 1371.2 prior to performing any work under a contract. Eligibility determinations will be based solely on the scientific and technical contributions of the contractor, as outlined in the statement of work. Foreign nationals who meet the eligibility requirements will undergo a rigorous approval and investigative process prior to physical access to the Center and/or to NASA information. Foreign nationals must be sponsored by a NASA Civil Service employee. The sponsor must submit a formal request to the Security Office for access to the Center and/or NASA information, to include electronic information. Normal processing time for a request is between 60 and 90 days depending on the nationality of the foreign national. All approvals will be for a maximum of one year, and must be resubmitted annually. Following approval, the foreign national will undergo a National Agency Check Investigation (NACI). As part of the NACI, the foreign national will submit a "Name Check Request" (NASA Form 531) and a completed "applicant" fingerprint card, to the LaRC Security Office, Mail Stop 450. Normal processing time for a NACI is between 90 to 120 days. Until the NACI is completed and favorably adjudicated, the foreign national will require complete escort from entry onto and exit off of the Center. Upon completion of the NACI, the foreign national will only be granted unescorted access to an approved workplace during normal weekday work hours between 6:00 a.m. and 6:00 p.m. The foreign national will not be granted access during non-work hours, weekends, and holidays. Derogatory information developed concerning the foreign national may be grounds for visit termination.

1.7 SCHEDULING OF WORK

The established hours of work at Langley Research Center are 7:00 a.m. to 4:30 p.m. Monday through Friday, excluding U.S. Government holidays and closings declared by Administrative or Executive order.

In order that the necessary and proper inspection of the Contractor's work may be effectively accomplished, and to assure the availability of required Government facilities, the Contractor shall schedule work performance hereunder to be compatible with the established work week, hours of work and legal holidays observed by the Government organization having cognizance over the work performed at the particular work site. No work shall be performed during other hours without prior authorization of the Contracting Officer.

All requests for overtime work shall be submitted to the Inspector 24 hours prior to the proposed overtime.

The Contractor shall give at least 72 hours notice to the Construction Services Unit (CSU) and the Office of Safety and Facility Assurance of the date when the contract work will begin at the site.

If the Contractor suspends work at any time, it shall notify the CSU and shall not again resume work without notifying the CSU in advance.

1.8 ADDRESSING CORRESPONDENCE, SUBMITTALS AND INVOICES

All correspondence, submittals and invoices shall be clearly marked with the assigned Government contract number. Unless otherwise specified herein, the Contractor shall submit an original and five copies of all correspondence and submittals.

The Contractor shall submit all shop drawings, test reports, equipment data sheets, and any other technical data under an original cover letter and with copies as required by these specifications. Samples shall also be accompanied by a cover letter and appropriate copies.

Correspondence and submittals shall be addressed to the designated Government addressee(s) and mail stop(s) shown in the Submittal Summary of Section 01330 to the following address:

All correspondence to the Contracting Officer or Contract Administrator shall be addressed as follows:

Contracting Officer/Contract Administrator, Mail Stop 126
Contract NAS1- _____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

All correspondence to the Contracting Officer Technical Representative (COTR) shall be addressed as follows:

COTR, Mail Stop 465
Contract NAS1- _____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

Progress payment, final payment invoices, and Contractor's release form (NASA Form 778) shall be addressed as follows:

Accounts Payable and Employee Services Branch, Mail Stop 175
Contract NAS1- _____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

Certified payrolls shall be addressed as follows:

Construction Services Unit, Mail Stop 428
Contract NAS1- _____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

Submittals to the Office of Safety and Facility Assurance shall be addressed as follows:

Office of Safety and Facility Assurance, Mail Stop 429
Contract NAS1-_____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

Submittals to the Environmental Management Office shall be addressed as follows:

Environmental Management Office, Mail Stop 418
Contract NAS1-_____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

1.9 SCHEDULE OF CONSTRUCTION, MONTHLY PROGRESS SCHEDULES AND MONTHLY TECHNICAL PROGRESS NARRATIVES

1.9.1 Schedule of Construction

Within 30 days after date of receipt of Notice to Proceed, the Contractor shall submit to the Contracting Officer for approval, 6 copies of a practical and feasible schedule of construction on Form LF-107, Contract Progress Schedule Report. This schedule shall indicate the sequence of work the Contractor plans to complete the contract within the specified completion period and shall include, as a minimum, the following categories of work:

Mobilization
Demolition of existing Mach 20 tunnel
Removal of asbestos containing materials
Other demolition
Relocate/modify existing 2' x 3' tunnel
Construct control room
New finishes
Raised access floor
HVAC equipment
HVAC ductwork
Fire protection piping
Electrical
Punch list
As-builts
Close-out

Upon Contracting Officer approval of the schedule of construction, this approved schedule shall be utilized by the Contractor for its contract progress schedule reporting. The Contractor shall adhere to the approved schedule of construction. The schedule of construction shall not be altered without the written approval of the Contracting Officer. In the event of changes in the schedule of construction, under applicable provisions of the contract, the Contractor shall resubmit the schedule of construction reflecting such changes.

1.9.2 Monthly Progress Schedules and Monthly Technical Progress Narratives

The Contractor shall submit the following reports covering work accomplished each month of contract performance. The technical progress narrative and the monthly progress schedule, on Form LF-107, (Attachment 1), shall be prepared covering a period from the tenth of one month through the ninth of the following month and shall be submitted so as to be

received no later than the 15th of the month in which the reporting period ends. The Contractor shall certify the accuracy of monthly reports being submitted by signing the technical progress narrative and block 4 of Form LF-107.

1.9.2.1 Monthly Progress Schedules

Monthly progress schedules, on Form LF-107, shall be prepared in accordance with the instructions on the reverse side of the form and shall show both the NASA approved schedule and the Contractor's current working schedule.

1.9.2.2 Monthly Technical Progress Narratives

Monthly technical progress narratives shall be brief, factual, and informal and shall be prepared in accordance with the following format:

A cover page containing:

Contract number and title.

Period of performance being reported.

Contractor's name and signature.

Date of publication.

Summary outlook - A short statement summarizing the current time status in relation to plan as well as the outlook for achieving major goals.

Status versus plans.

Significant progress - A description of overall progress plus a separate description for each reporting category on the contract progress schedule (Form LF-107) on which effort was expended during the reporting period.

Problem areas - A description of current problems and their schedule and resource implication which may impede performance.

Corrective actions - A description of corrective action which has been taken or which is planned to correct any existing problem.

Plans - A description of work to be performed during the next reporting period.

Recommendations - Recommendations for action on the part of Langley Research Center.

1.10 AS-BUILT DRAWINGS

The Contractor's construction drawings shall be used to create a full-size set of "As-Built" Contract Drawings to be maintained during the project's site construction phase. The As-Built Drawings shall accurately reflect the current configuration of the design and construction, and shall be red-lined concurrently with any changes being made. The Contractor shall implement an established drawing control process to ensure that design changes are communicated to construction personnel and to the Government for approval in a timely manner. The As-Built Drawings shall be maintained at the construction site, and shall be available for inspection any time by

the Contracting Officer. The Contractor shall submit one (1) copy of these marked up drawings to the Contracting Officer at the end of the contract period for Government review and approval prior to final payment and acceptance of the contract.

1.11 FINAL DRAWINGS

At the completion of the construction, all drawings shall be revised and updated to incorporate the as-built red-lines. These drawings shall be stamped "AS-BUILT CONDITIONS" on each sheet or page, dated, and signed by the Contractor. The final drawings shall be submitted to the Contracting Officer in both hard copy and electronic format for Government review and approval prior to final payment and acceptance of the contract.

1.12 OPERATIONS AND MAINTENANCE (O & M) MANUALS

The Contractor shall submit for approval the Operation and Maintenance (O & M) Instruction Manuals for the equipment specified under the various headings of these specifications. These submittals shall be complete and detailed.

1.13 PRICE BREAKDOWN FOR DETERMINING PROGRESS PAYMENTS

The Contractor shall submit a price breakdown if it intends to request progress payments. Price breakdown shall be divided into the contract work elements and bid options and further into disciplines of work. Price breakdown shall also have separate line items for subcontracted work. The Contractor shall submit with the price breakdown, a list of all subcontractors and their subcontract prices. Where several items are involved, each shall be shown separately. This breakdown shall be prepared using the items, major parts, and components which were approved by the Contracting Officer for the schedule of construction, as required above, to provide a schedule/price correlation for use in the assessment of progress payments, and shall separate equipment and material prices from labor prices for each portion of the work. No progress payments will be made until the price breakdown, as submitted, has been approved by the Contracting Officer.

1.14 PRICE BREAKDOWN FOR MODIFICATION PROPOSALS

The Contractor shall furnish an itemized price breakdown within 14 calendar days of receipt of a Government change order or request for proposal. Unless otherwise directed, the breakdown shall be in sufficient detail to permit an analysis of all material, labor, equipment, subcontract and overhead costs as well as profit, and shall cover all work involved to accomplish the modification whether deleted, added, or changed. Subcontractor costs shall also be supported by similarly detailed price breakdown. If the proposal includes a requested time extension, a detailed justification shall also be furnished. The Attachment 2 forms shall be used to furnish this price breakdown.

1.15 MINIMUM EMPLOYEE COMPENSATION

The U.S. Department of Labor Wage Determination, Enclosure 4 of the Solicitation, establishes the minimum compensation levels for laborers and mechanics employed on site at the Langley Research Center.

Certified payrolls for on-site work of the prime Contractor and all subcontractors shall be submitted weekly as required by Section 01330,

Submittals.

1.16 CONTRACTOR RELEASE FORM

The Contractor shall execute and submit a Contractor Release Form, NASA Form 778, at contract completion.

1.17 PROJECT SIGN

The Contractor shall furnish and install a project sign at the location designated by the Contracting Officer, immediately upon beginning site work. The sign shall conform to the details shown in Attachment No. 3 of this section. The sign shall be mounted on a substantial treated wood framework of at least 2 inch by 4 inch material. The sign shall be 4-by 8-foot exterior grade plywood and constructed of nominal 1 inch material. It shall have black letters on a white background of lead free alkyd primer and two coats of exterior type white enamel. The border shall be 3/4-inch wide and shall be black. The Contractor shall erect no other display sign at the site.

1.18 BULLETIN BOARD

Immediately upon beginning site work, the Contractor shall provide at the job site a weatherproof bulletin board for displaying the Fair Employment Act, wage rates, and safety bulletins and posters. The bulletin board shall be located in a conspicuous place, easily accessible to all employees. Legible copies of the aforementioned data shall be displayed until on-site work is complete.

1.19 ORDER STATUS REPORTS

Upon request of the Contracting Officer, the Contractor shall submit timely reports showing the status of any orders or subcontracts which may delay or are delaying the overall contract schedule. Order status reports shall include:

Contract or order number, date submitted to the supplier, date accepted by the supplier, supplier's name and address.

Delivery date needed to meet contract schedule.

Delivery date agreed to by the supplier, and any subsequent changes in that date.

Reasons for changes in delivery dates.

Effect which the latest promised delivery date will have on the contract schedule.

A summary of the Contractor's efforts to bring the promised delivery date in line with the requirements of the contract schedule, including efforts made to place the order or subcontract with other suppliers.

1.20 SALVAGE MATERIAL AND EQUIPMENT

Any items of material designated by the Contracting Officer as salvage shall remain the property of the Government.

Such items shall be segregated, itemized, delivered, and off-loaded at the

Government designated storage area located on the Langley Research Center.

The following items are hereby designated as "salvage" and shall be removed and turned over to the Government:

Mach 20 Helium Tunnel
All existing piping indicated to be removed

The Government will provide a metal dumpster onsite for the disposal of miscellaneous steel piping. The Contractor will be responsible to load Mach 20 Helium Tunnel structure into Government trailers for transportation by the Government.

The Contractor shall maintain property control records for material or equipment designated as salvage. The Contractor's system of property control may be used if approved by the Contracting Officer. The Contractor shall be responsible for storage and protection of salvaged materials and equipment until disposition by the Contracting Officer. Any salvage materials which are of a hazardous nature shall be handled as required by Section 01060, Langley Safety and Environmental Requirements, and applicable Federal and/or State regulations.

The Contractor shall submit to the Contracting Officer a written damaged property non-conformance letter within 24 hours of removal of salvage material or equipment if such equipment is not in the condition or quantity contractually specified.

The Contractor shall replace or repair, at no cost to the Government, all salvaged materials and equipment which are broken, damaged, or lost due to the Contractor's negligence while such items are in the Contractor's possession.

1.21 MATERIALS AND EQUIPMENT

Materials and equipment provided shall be standard catalog products of manufacturers regularly engaged in the manufacture of the products unless otherwise specified herein.

Materials and equipment shall meet the requirements of the contract and shall be suitable for the specified installation. Where two or more units of the same equipment class are furnished, the equipment shall be from the same manufacturer and shall be interchangeable. Materials and equipment shall be new and free from defects.

Where equipment specified by designations of the manufacturer requires modification to fully meet contract requirements, such modification shall be made by the Contractor without additional cost to the Government.

Where two or more types of equipment or materials are specified without indication of preference, it shall be optional with the Contractor which one is used; but the same type shall be used throughout.

Where equipment or materials are specified by the designations of the manufacturer, "or equal", the Contractor, if it elects to furnish other than the brand name product, is responsible for any necessary redesign, relocation and rework of associated construction, at any time during the course of the contract. The proposed materials or equipment substitution with any required redesign, relocation, or rework data shall be submitted for approval of the Contracting Officer.

All equipment and material data, including location, function, and characteristics shall be furnished to the Contracting Officer for approval as specified in the following sections. Machinery, equipment, materials, and articles furnished without such approval shall be at the risk of subsequent rejection, and will not be considered in computing progress payments.

1.22 MATERIAL AND EQUIPMENT INSTALLATION

Material and equipment shall be installed in accordance with the requirements of the contract drawings and Government approved recommendations of the manufacturers. Degradation of the designated fire ratings of walls, partitions, ceilings, and floors by the installation shall not be permitted.

1.23 HANDLING/PROTECTION OF CONTRACTOR MATERIAL AND EQUIPMENT

All shipments shall be addressed to the Contractor and the Contractor shall be responsible for their receipt, unloading, handling, and storage at the site. The Government will not accept deliveries on behalf of the Contractor or its subcontractors, nor assume any responsibility for security of materials, equipment or supplies delivered to the site.

The Contractor shall at all times protect and preserve all contractually required materials, supplies and equipment of every description (including property which may be Government-furnished or owned) and all work performed. If, as determined by the Contracting Officer, material, equipment, supplies and work performed are not adequately protected by the Contractor, such property may be protected by the Government and the cost thereof will be charged to the Contractor.

When Government-owned equipment is to be utilized by the Contractor at the construction site, the Contractor shall jointly inventory such equipment with the assigned Inspector, mutually agreeing as to condition and quantities. Upon completion of the inventory, the Contractor shall accept the equipment and give the Government a signed receipt. The Contractor shall be responsible for the equipment, its protection from damage, and availability for installation. Even in the absence of such a joint inventory, the Contractor assumes full responsibility for such Government-owned equipment when it comes into its possession. The Contractor shall submit a record of existing conditions prior to use of Government-owned equipment.

1.24 ON-SITE CLEAN-UP AND DISPOSAL OF MATERIALS

If the operations of the Contractor result in deposition of dirt or other debris on paved areas, it shall clean such facilities at such intervals and in such manner to prevent the formation of undesirable quantities of mud or dust, and avoid making any other nuisance.

The Contractor shall not dispose of materials of hazardous or environmentally damaging nature into the storm or sanitary sewer systems. The Contractor shall be responsible for proper handling and disposal of hazardous wastes generated by its activities in accordance with applicable federal, state and local regulations. See Section 01060, Langley Safety and Environmental Requirements, for additional hazardous waste disposal requirements.

Scrap materials removed and not specified for reuse or for return to the Government shall become the property of the Contractor and shall be removed from the Government premises and properly dispositioned.

Excess excavated material not specified to be reused in the construction shall become the property of the Contractor and shall be removed from the Government premises and properly dispositioned.

Excess excavated fill and topsoil material not specified to be reused in the construction shall be disposed of in one or more areas of LaRC as directed by the Contracting Officer. Such material shall be leveled to provide a reasonably flat surface free of depressions. When necessary, written permission to stockpile excavated material at the site may be requested from the Contracting Officer.

When construction work is performed in Government facilities and the Government continues to use these areas, the Contractor shall keep floors and platforms swept broom clean daily of any debris created by its work. Debris shall be stored in closed metal containers and shall be removed from these areas at least weekly.

In other construction areas, all waste material, scrap lumber and rubbish shall be collected and stored in piles or containers. This material shall be removed weekly from the site or more often if the material constitutes a fire hazard.

Application equipment shall be cleaned promptly and thoroughly with a suitable solvent after each use and stored in a clean, covered, well-ventilated container.

At the end of each working day, all discarded paint materials, rubbish, rags and other similar materials shall be collected and removed from the project area.

At the completion of the work, the Contractor shall remove all paint spots from finished surfaces and leave the project in a clean condition.

1.25 UTILITY OUTAGES AND POWER CONNECTIONS

1.25.1 Utility Outages

Work shall be scheduled to hold outages to a minimum.

Utility outages required during the prosecution of work that affect existing systems shall be scheduled at the convenience of the Government. Any interruption of utilities or services that would interfere with the operation of a facility will be permitted only on week-ends between the hours of 12:00 midnight Friday and 10:00 p.m. on the following Sunday. The Contracting Officer may permit interruptions at other times. Any utilities or service connections made at other than normal working hours shall be at no additional cost to the Government. Permission to make such an interruption shall be requested in writing to the Contracting Officer at least seven calendar days prior to the day of interruption.

All work necessitating power shutdowns or outages shall be scheduled with the Contracting Officer 7 days in advance by submitting a written request for utility outage stating the date and time the desired interruption will commence, the anticipated period of interruption, and feeders and circuits to be interrupted. No interruption shall be made without authorization

from the Contracting Officer. If a scheduled power interruption is to extend into the regular working hours, the Contractor shall notify the Contracting Officer 24 hours in advance.

1.25.2 Application for Connecting to Government Electrical Utilities

Prior to making connection to any part of the Government's electrical power distribution system, the Contractor shall make application to the Contracting Officer stating the date, time, location, and the service required. The Contractor shall also state when such connection is desired.

Before granting the Contractor permission for such connection, the Government will make the necessary checks of the Contractor's system to assure its adequacy and safety and that the Government's supply is adequate at that point for such connection.

Initial energizing of all new electrical equipment shall be done only in the presence of an authorized representative of the Contracting Officer.

Prior to connecting into any existing Government electrical utility, the Contractor shall conform to the requirements of Section 01060.

1.26 USE OF GOVERNMENT PREMISES

The Contractor shall submit a record of existing conditions detailing Government property that has pre-existing damage. The existing conditions will be reviewed and approved by the Contracting Officer's Technical Representative.

1.26.1 Boundaries and Site Requirements

Boundary lines on drawings are for delineation of the general working area. Such lines do not relieve the Contractor of its responsibility for completing construction features, utility runs or tie-ins which cross or extend beyond such limit lines as provided by specifications or drawings requirements.

1.26.2 Adjacent Premises and Existing Services

Government premises adjacent to the construction will be made available for use by the Contractor, without cost, whenever such use will not interfere with other Government uses or purposes. The Contractor shall promptly vacate such premises if ordered to do so by the Contracting Officer. When the contract work is to be connected to existing buildings or other construction, the Contractor shall do such repairs and cleanup as may be necessary to leave the completed work in a neat and orderly condition.

Existing services shall be maintained without interruptions, or, if interrupted by the operations of the Contractor, shall be promptly restored. Existing roads and sidewalks may be blocked by the Contractor only by permission of the Contracting Officer, obtained 24 hours in advance, and the Contractor shall provide a temporary by-pass during such operations, unless otherwise directed.

1.26.3 Vehicle Weight Limits

Roads at the Langley Research Center are limited to axle loads of less than 32,000 pounds. The Contractor shall not exceed these limits. When it is necessary to cross curbing or sidewalks, secure bridges shall be

constructed across them, and at the completion of all work such bridges shall be removed.

1.26.4 Heavy Equipment Movement

Heavy equipment such as cranes, shall not be moved on the paved roadways of the Langley Research Center without prior approval of the Contracting Officer or its designee. Tracked equipment shall be transported on trailers unless the Contracting Officer issues a prior approval to the contrary. Movement of heavy equipment over the paved roadways of the Langley Research Center shall be only at times acceptable to the Contracting Officer and shall not obstruct vehicular traffic. In no event shall such equipment traverse temporary roadway bridging without the Contracting Officer's prior approval.

1.27 BARRICADES AND TRAFFIC CONTROL

Work shall be conducted to minimize obstruction of traffic, and traffic shall be maintained on at least one half of the roadway width at all times. Approval of the Contracting Officer shall be obtained before starting any activity that will obstruct traffic. Barricades and traffic control devices shall comply with Section 01060, Part 1.22, Signs, Signals and Barricades.

1.28 ON-SITE UTILITIES

1.28.1 Water

Water will be furnished by the Government without charge. Lines shall be installed and maintained in a sanitary and watertight manner, and shall be removed and capped at the completion of the contract. Water will be made available within 150 feet of the job site.

1.28.2 Electrical Power

The Government will furnish electric power for general construction purposes, with a maximum demand of 25 kilowatts, without cost to the Contractor. This electrical energy will be made available to the Contractor, and will be supplied at three-phase, four-wire, 60 cycles, 120/208 volts. The Contractor shall furnish and install a disconnect switch, suitably protected from the weather, and fused for 75 amps or less, at the delivery point designated. The Contractor shall connect the switch to the power source designated. All temporary lines extended from the disconnect switch shall be furnished by the Contractor, and shall be installed and maintained in a safe and workmanlike manner. The installation of the construction power system shall comply with OSHA requirements and with Article 305 of the National Electrical Code. All temporary lines and the disconnect switch shall be removed by the Contractor at the completion of the contract. This electrical energy is provided for lighting, motor-driven construction equipment, heaters and humidity control of equipment and machinery, and general construction purposes only.

1.28.3 Telephone Service

The Government will not provide telephone service for use by the Contractor. The Contractor may make arrangements for the installation and maintenance of on-site telephone service and for removal of same upon completion of the contract. However, this shall be done in accordance with

NASA regulations and telephone company requirements and only after consultation with a designated representative of the Langley Research Center. The Contractor may call (757) 864-7777 for further information and arrangements.

The Contractor will be charged a $234.00 fee for an on-center phone connection. The use of private cellular phones is encouraged.

1.29 ON-SITE GOVERNMENT/CONTRACTOR/SUBCONTRACTOR COORDINATION

The existing facility will be occupied by the Government during construction. The Contractor shall coordinate its work with the Contracting Officer to ensure minimum interference with Government activities during construction.

Other Contractors will not be working at the site of the work during the performance of this contract.

The Contractor shall be responsible for familiarizing each of its subcontractors with all requirements (this includes administrative as well as technical) of the contract affecting each subcontractor, respectively. The Contractor shall be responsible for coordinating the work of its subcontractors or suppliers to prevent any interference or omission whatsoever. The divisions or sections of the specifications shall not be interpreted as limiting or defining the work for purposes of dividing the work among subcontractors, or to limit the work performed by any trade.

The Contractor shall be responsible to the Government for acts and omissions of its own employees and of subcontractors and their employees. The Contracting Officer will not undertake to settle any differences between the Contractor and its subcontractors, or between subcontractors. All business pertaining to the contract shall be conducted through the Contractor. If the Contractor specifically authorizes in writing a subcontractor to act as its agent, it shall state the specific authority conferred. The Contractor shall also be bound by any agreement made between the agent acting within the scope of its authority and the Government.

1.30 SANITARY CONVENIENCES

The Contractor shall provide and maintain all necessary sanitary conveniences for use of its employees, as directed by the Contracting Officer. The criteria for determining the adequacy of such facilities provided shall be as stated in the Department of Labor, Safety and Health Regulations, as amended. These facilities shall be kept clean and their use shall be strictly enforced.

1.31 PLUMBING WORKERS' QUALIFICATIONS

All plumbing work shall be performed by plumbing tradesmen who have in their possession a current Apprentice, Journeyman, or Master's plumbing license card, as issued by the State of Virginia. When plumbing tradesmen do not have such a Virginia card or license, the Contractor shall submit for approval evidence that such tradesmen have equivalent permits issued by other Governmental jurisdiction. Such equivalency submittal shall include documentation defining the criteria required for licensing by the involved jurisdiction, so that the Contracting Officer can determine that valid equivalency exists.

1.32 ELECTRICAL WORKERS' QUALIFICATIONS

All electrical work shall be performed by electrical tradesmen who have in their possession a current Apprentice, Journeyman, or Master's Electrical License Card, as issued by the State of Virginia. When electrical tradesmen do not have such a Virginia license, the Contractor shall submit for approval by the Contracting Officer, evidence that such tradesmen have equivalent permits issued by other Governmental jurisdictions. Such equivalency submittals shall include documentation defining the criteria required for licensing by the involved jurisdiction, so that the Contracting Officer can determine that valid equivalency exists.

1.33 MECHANICAL WORKERS' QUALIFICATIONS

All mechanical work shall be performed by mechanical tradesmen who have in their possession a current Apprentice, Journeyman, or Master's mechanical license card, as issued by the state of Virginia. When mechanical tradesmen do not have such a Virginia card or license, the Contractor shall submit to the Contracting Officer for approval, evidence that such tradesmen have equivalent permits issued by other Governmental jurisdiction. Such equivalency submittal shall include documentation defining the criteria required for licensing by the involved jurisdiction, so that the Contracting Officer can determine that valid equivalency exists.

1.34 INSPECTION RECORDS

In accordance with FAR Clause 52.246-12, "Inspection of Construction", (August 1996), the Contractor shall maintain daily inspection records and make them available to the Contracting Officer. Attachment 4 shall be used to maintain the required inspection records.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Langley Research Center Hampton, Virginia 23681-2199	**CONTRACT PROGRESS SCHEDULE REPORT**	1. REPORTING FOR MONTH ENDING

2. CONTRACT TITLE:	3. CONTRACTOR (Name and Address)	5. CONTRACT NO. LATEST MOD. NO.
	4. APPROVED (Contractor's Project Manager) Date	6. NASA APPROVED DATE

7. REPORTING CATEGORY	8. SCHEDULE PROGRESS	9. TECH OBJECTIVE % COMPLETE

NASA APPROVED BASELINE SCHEDULE

CONTRACTOR'S CURRENT OPERATING SCHEDULE

INSTRUCTIONS FOR COMPLETING OF THE CONTRACT PROGRESS SCHEDULE REPORT

(Previously NASA C-63)

Obtain forms from the NASA-Langley Research Center Contracting Officer.

Refer to the submittal instructions in the contract Statement of Work (SOW) _____ for space and flight projects, and sections 01011 and 01330 for facilities projects.

Block Entries

1. The ending date of the accounting month being reported.
2. The contract title as shown on the cover page of the contract.
3. The full name and address of the contractor (if a division of the contractor is performing the work, use the division name and address).
4. Contractor's Project Manager's signature and date approved.
5. The complete NASA contract number and latest modification number.
6. The date the NASA Project Manager for space and flight projects/Contracting Officer's Technical Representative (COTR), for facilities projects approved the original baseline schedule. If the original baseline schedule is revised, ONLY USE the date the NASA Project Manager/COTR approves the revision.
7. The WBS reporting categories agreed to in the current negotiated contract. (See SOW _____ or section 01011.)
8. The attached chart shall be used to show the schedules and status of the Work Breakdown Structure (WBS) reporting categories.

Top line:	The calendar years.
Second line:	The first letter of each month starting with the month of the contract award.
Time-now indicator:	Make a vertical broken line to indicate the end of the reporting month.
Shaded blocks:	Use open triangles to indicate the start and completion milestones. This line shall show the current NASA-approved schedule for each WBS reporting category.
Unshaded blocks:	Use an open schedule bar to indicate the time span of the Contractor's current operating schedule. Place an open triangle at the end of the open bar to represent the completion milestones. The contractor's current operating schedule may be the same as, or different from the current NASA-approved baseline schedule.

To show schedule status to time-now, determine the length of time allocated in the baseline schedule for the technical achievement to date. Then blacken the schedule bar to the time point in the baseline schedule that represents this technical achievement to date. Blacken the completion triangle at the point in time each milestone is actually achieved. Consider any modifications made in the current working schedule. NOTE: The percent-ratio of the blackened portion of the schedule bar to its total schedule is not necessarily the same as the percent completion of the technical objective. The percent of manhours or dollars used to date is not a measure of schedule progress for end-item WBS categories.

Use arrows (< >) to indicate a break in scheduled activity.

Place a number (1,2,3, etc.) within a triangle to indicate number of times officially rescheduled. The baseline triangles are a permanent part of the schedules. After displaying the prior milestone triangle for 1 month, it should be deleted (leaving only the current re-scheduled triangle).

9. Evaluate the progress toward meeting the technical objective of each reporting category. Enter an estimated percentage that indicates the progress toward the technical objective actually achieved as of the Report for Month Ending date.

   Consider all aspects of progress: technical specifications met, quality, production of hardware, software achievement, etc. Subjective factors, such as complexity of tasks, state-of-the-art, and level of confidence that the objective can be achieved, should be considered. Use actual costs or manhours to date as a guide to determine technical achievement ONLY if there is a direct correlation.

ESTIMATE FOR CONTRACT MODIFICATION CHANGE ITEM NO. _____ DATE _____

CONTRACT NO: NAS1- _____

PROJECT TITLE:

MODIFICATION DESCRIPTION:

	PRIME CONTRACTOR'S WORK				Revisions/Comments
1. Direct Materials					
2. Sales Tax on Materials	4.50 % of line 1	4.50 %			
3. Direct Labor (including fringe benefits)					
*4. Insurance & Taxes	_____ % of line 3	%			
5. Rental Equipment					
6. Sales Tax on Rental Equipment	4.50 % of line 5	4.50 %			
7. Equipment Ownership and Operating Expenses					
8. SUBTOTAL (Add lines 1–7)					
9. Overhead (Field + Home Office)	_____ % of line 8	%			
10. SUBTOTAL (Add lines 8 and 9)					
11. Prime Profit	_____ % of line 10	%			
12. SUBTOTAL (Add lines 10 and 11)					

Prime Remarks:

	SUBCONTRACTOR'S WORK				Revisions/Comments
13. Direct Materials					
14. Sales Tax on Materials	4.50 % of line 13	4.50 %			
15. Direct Labor (including fringe benefits)					
*16. Insurance & Taxes	_____ % of line 15	%			
17. Rental Equipment					
18. Sales Tax on Rental Equipment	4.50 % of line 17	4.50 %			
19. Equipment Ownership and Operating Expenses					
20. SUBTOTAL (Add lines 13-19)					
21. Overhead (Field + Home Office)	_____ % of line 20	%			
22. SUBTOTAL (Add lines 20 and 21)					
23. Profit	_____ % of line 22	%			
24. SUBTOTAL (Add lines 22 and 23)					

Sub's Remarks:

	SUMMARY				Revisions/Comments
25. Prime Contractor's Work (from line 12)					
26. Subcontractor's Work (from line 24)					
27. Prime's Commission on Subcontractor Work	_____ % of line 20	%			
28. SUBTOTAL (add lines 25, 26, and 27)					
29. Prime Contractor's Bond	_____ % of line 28	%			
30. TOTAL COST (Add lines 28 and 29)					

Estimated time extension and justification

Prime Contractor Name:

Subcontractor Name:

Signature of Preparer

Title of Preparer

*THIS ITEM MAY ONLY INCLUDE LABOR BURDEN FOR FICA, FUTA, SUTA, AND WORKER'S COMP.

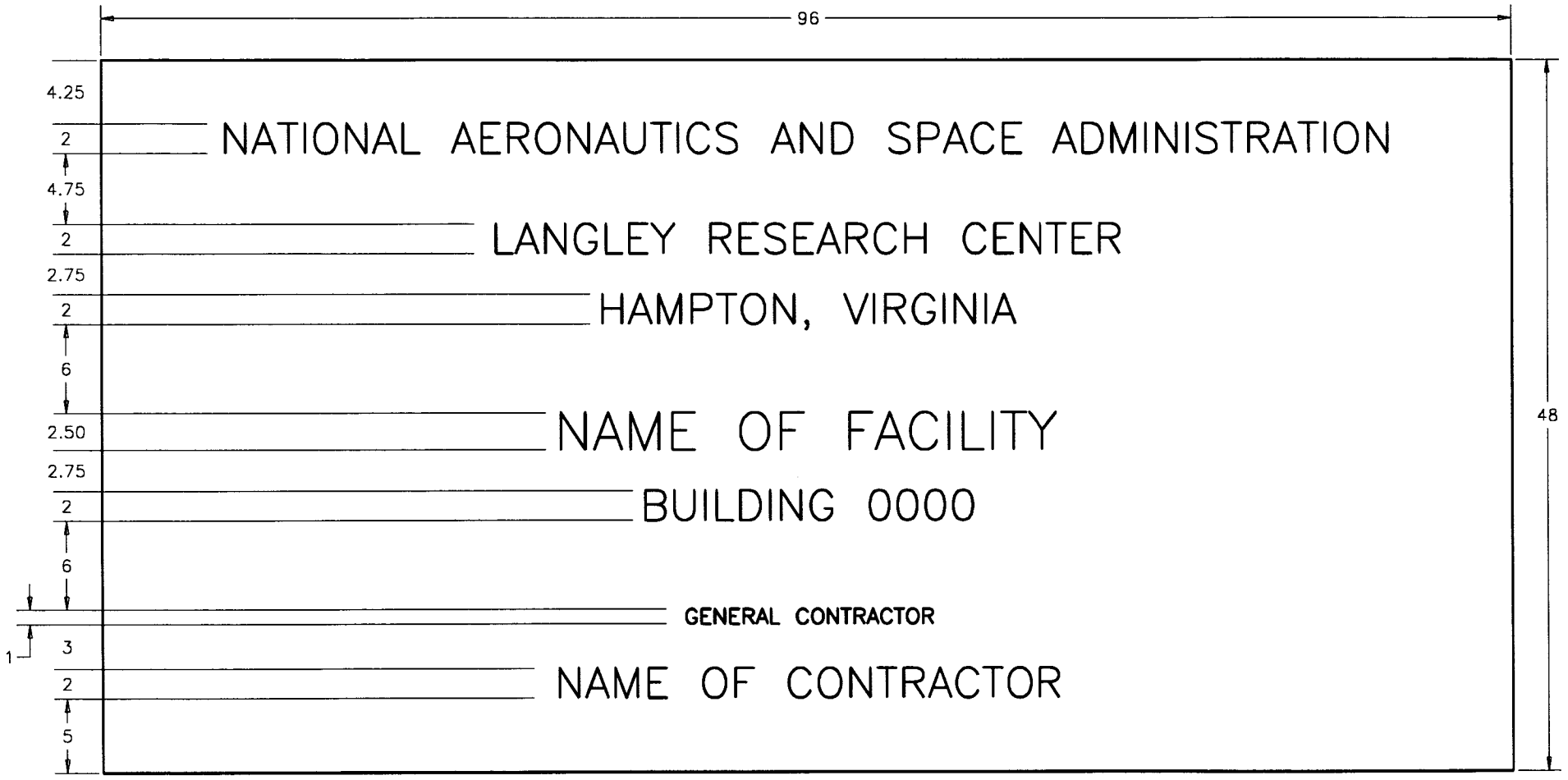
ESTIMATE FOR CONTRACT MODIFICATION CHANGE ITEM NO: _____ CONTRACT NO: NAS1- _____

BREAKDOWN OF DIRECT COSTS

DATE _____

Work Items Prime Contractor		QTY	UNIT	MATERIAL COST		LABOR COST		O = Owned R = Rental	EQUIPMENT			
				Per Unit	Total	Per Unit	Total		Qty	Rate	Owned	Rental
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												
11,												
12.												
13.												
14.												
15.												
16.												
17.												
18.												
19.												
20.												
DIRECT Prime Contractor's TOTAL					**Mat/Cost Total**		**Labor/Cost Total**				**Owned Total**	**Rental Total**

Work Items Subcontractor		QTY	UNIT	**MATERIAL COST**		**LABOR COST**		O = Owned R = Rental	**EQUIPMENT**			
				Per Unit	Total	Per Unit	Total		Qty	Rate	Owned	Rental
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												
11,												
12.												
13.												
14.												
15.												
16.												
17.												
18.												
19.												
20.												
DIRECT Subcontractor's TOTAL					**Mat/Cost Total**		**Labor/Cost Total**				**Owned Total**	**Rental Total**



ALL DIMENSIONS IN INCHES

Daily Construction Report

Date

Contract No.	Title and Location
Contractor	Superintendent or Foreman
Weather / Temperature ^{o}F	

Weather Affects Delay Critical Path Activity ☐ Yes ☐ No

Prime Contractor/Subcontractor Workforce
(if space provided below is inadequate, use additional sheets)

Location and Description Of Work Performed

No.	Trade	Hours	Employer	
Total Work Hours on Job Site This Date				Were there any lost time accidents this date? ☐ Yes ☐ No If yes, a copy of the completed NASA Form 95 is required.

Material Received and Equipment On-Site *(w/value > $10,000)*

Test Performed *(give brief description of test performed)*

Remarks *(Include directions received from CO/COTR, Safety; compliance notices received; pertinent information.)*

☐ Check if continued on other side

Contractor/Superintendent

Date

Inspector's Remarks and/or exceptions to this report

☐ Check if continued on other side

Inspector

Date

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SECTION 01060

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-- End of Section Table of Contents --

SECTION 01060

LANGLEY SAFETY AND ENVIRONMENTAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.1	(1994) Safety Requirements for Ladders - Portable Wood
ANSI A14.2	(1990) Safety Requirements for Portable Metal Ladders

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR Part 1904	Recording and Reporting Occupational Injuries and Illnesses
29 CFR Part 1910	(1995) Occupational Safety and Health Standards
29 CFR Part 1926	Safety and Health Regulations for Construction
40 CFR Part 61	(1995) National Emissions Standard for Asbestos

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

ANSI/IEEE 95	(1997) Recommended Practice for Insulation Testing of Large AC Rotating Machinery With High Direct Voltage

LANGLEY RESEARCH CENTER (LaRC)

LAPD 1700.7	(March 2000) Traffic Management
LAPG 1710.10	(October 2001) Safety Clearance Procedures (Lockout/Tagout)
LAPG 1740.2	(July 1999) Facility Safety Requirements
LAPG 8800.1	(April 2000) Environmental Program Manual

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA-STD-8719.11	NASA Safety Standard for Fire Protection

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(1998) Standard for Portable Fire Extinguishers
NFPA 30	(2000) Flammable Liquids Code
NFPA 31	(2001) Standard for the Installation of Oil-Burning Equipment
NFPA 51	(1997) Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding and Allied Processes
NFPA 51B	(1999) Standard for Fire Prevention in Use of Cutting and Welding Processes
NFPA 54	(1999) National Fuel Gas Code
NFPA 58	(2001) Standard for the Storage and Handling of Liquefied Petroleum Gases
NFPA 101	(2000) Life Safety Code
NFPA 211	(2000) Standard for Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances

VIRGINIA CODE COMMISSION (VR)

VR 672-10-1	State Regulations (VR)

OTHER

Instrumentation, Systems, and Automation Society (ISA)
National Electrical Manufacturers Association (NEMA)
Electronic Industries Association (EIA)
Insulated Power Cable Engineers Association (IPCEA)
Institute of Electrical and Electronics Engineers, Inc. (IEEE)
Association of Edison Illumination Companies (AEIC)

1.3 SUBMITTALS

The following shall be submitted in accordance with the requirements of Section 01330, "Submittals":

SD-08 Statements

Safety Plan

Application for Working on Energized Electrical Circuits Below 600 Volts

Electrical Safety Workers Qualifications

Application for Making Connection to Government Electrical Utilities

Energized Substations Work Plan

Power Outage Request

Soil Erosion and Sediment Control Plan (For disturbed contiguous soil areas greater than 10,000 square feet)

Virginia Soil and Erosion Control Handbook Standards Variance Plan

Asbestos Handling License

Proof of Notification of Proposed Asbestos Work to Virginia and EPA

Asbestos Operational Procedure

Certified Statement for Off-Site Transportation of Asbestos Products for Disposal

Signed Manifest to Document Receipt of Asbestos

List of Riggers

Sewer Disposal Permit

1.4 GENERAL SAFETY REQUIRMENTS

1.4.1 Safety Plan

On-site work shall not commence prior to the Contracting Officer's approval of the Safety Plan.

The Contractor safety plan is a written plan prepared by the Contractor summarizing the overall safety program that will cover the employees and equipment used to fulfill the contract. The safety plan shall address all aspects of the contract to include manufacturing, construction, transportation, and testing. It is not intended that the Contractor's normal industrial home-plant safety rules and directives be subject to NASA approval. However, it is intended to ensure that the Contractor has an adequate safety program for on-site work. Attachment 1 to this section provides a list of items required to be addressed in the safety plan; however, special safety procedures may be required, depending on the scope of work, environmental conditions or area of operation.

The safety plan shall contain a brief summary and scope of the work to be performed.

The Contractor's safety representative, responsible for ensuring compliance with all applicable rules and regulations, shall be identified in the safety plan.

1.4.2 Recordkeeping

The Contractor shall have a log and summary of all recordable occupational injuries and illnesses for their company on an OSHA 200 form or its

equivalent at a central place. The on-site Contractor shall have the address and telephone number of the central place where the OSHA 200 log is maintained, and shall have personnel available at the central place during normal business hours to provide information, from the records maintained there, by telephone or by mail. (OSHA 29 CFR Part 1904)

1.4.3 Safety Briefing

The Contractor's on-site Superintendent, as well as a subcontractor representative from each on-site subcontractor supporting the effort, shall attend a Safety Briefing at the Office of Safety and Facility Assurance, Building 1162, Room 122, Langley Research Center (LaRC), prior to any on-site activity. Briefing times are 7:30 to 8:30 a.m., Monday, Wednesday and Friday. This effort will be coordinated with the required badging activity (a listing of personnel for the prime and subcontractors is required).

1.4.4 Inspections

In accordance with Section 107 of the Contract Work Hours and Safety Standards Act, a representative of the NASA Langley Research Center shall have the right of entry to any on-site area of contract performance to ensure compliance with all applicable rules and regulations. (OSHA 29 CFR Part 1926.3)

Any condition that threatens the safety or security of (1) personnel (2) Government property or equipment, or (3) information, or any conditions that affect LaRC's environmental compliance may be subject to immediate work stoppage, and shall not resume until directed by the Contracting Officer.

1.4.5 Housekeeping

During the course of construction, alteration, or repairs, form and scrap lumber with protruding nails, and all other debris, shall be kept cleared from work areas, passageways, and stairs, in and around buildings or other structures.

1.4.6 Illumination

Construction areas, aisles, corridors, offices, shops, and storage areas where work is in progress shall be lighted with either natural or artificial illumination. (OSHA 29 CFR Part 1926.26)

1.4.7 Ladders

All ladders (metal and wood) used on-site shall conform to ANSI A14.1 and ANSI A14.2.

1.4.8 Motor Vehicles and Mechanized Equipment

All contractor-owned vehicles shall abide by LaRC traffic regulations in accordance with LAPD 1700.7, "Traffic Management," and OSHA regulations in accordance with OSHA 29 CFR Part 1926.600 through 1926.606.

1.4.9 Hazardous Materials

In accordance with OSHA 29 CFR Part 1910.1200, the Contractor shall have a hazardous communications program, when applicable, available for each

chemical, oil, lubricant, or solvent used on the job-site. A Material Safety Data Sheet (MSDS) shall be available for each chemical used on the job-site.

1.5 SAFETY CLEARANCE PROCEDURES/LOCKOUT/TAGOUT

The safety clearance procedures described in LAPG 1710.10, "Safety Clearance Procedures (Lockout/Tagout)," apply to all persons performing work at LaRC who install, repair, maintain, or inspect electrical and mechanical apparatus or systems. Safety clearance procedures for contractors performing work at LaRC shall be performed as defined herein. Briefings and documentation relating to safety clearance procedures will be provided by the Office of Safety and Facility Assurance at the Safety Briefing.

The Contractor shall assure that each employee is familiar with these procedures and that they comply with them when performing work at LaRC. At the request of the Contractor, a LaRC Safety Operator will apply the locks/tags in accordance with LAPG 1710.10, "Safety Clearance Procedures (Lockout/Tagout).

A lock/tag shall be mandatory on all vent valves locked/tagged open and before any work is done on any pressurized system requiring the establishment of safety clearance. Where no pressurized system is involved and where the Contractor and the Contracting Officer agree that work can be done safely, the use of the lockout/tagout may be omitted. The use of the lockout/tagout may be omitted only when the worker to be protected and an individual that is qualified in the discipline of work and acceptable to the worker's supervisor and the Contracting Officer agree that the work can be done safely and that the conditions considered necessary for safety will be maintained throughout the duration of the work. ANY ONE OF THE ABOVE INDIVIDUALS MAY REQUIRE THAT LOCKOUT/TAGOUT BE USED.

Removal of any device from its system while the device is locked/tagged is not permitted. A qualified LaRC Safety Operator must remove the locks/tags from the device.

No person, REGARDLESS OF POSITION OR AUTHORITY, shall operate any switch, valve, or equipment which has an official lock/tag attached to it, nor shall such lock/tag be removed except as provided by Chapter V of LAPG 1710.10. Removal of any device from its system while the device is "Locked/Tagged" is not permitted. A qualified NASA Safety Operator will ensure the system is safe and will remove the locks/tags before the device is removed.

No person shall work on any equipment, which requires a lock/tag unless the employee, its immediate supervisor, project leader, or a subordinate has control of the unsigned stubs of the required locks/tags.

When it is required that certain equipment be locked/tagged, the LaRC Safety Operator will take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the systems and equipment safe and will apply the locks/tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is hereinafter referred to as "Providing Safety Clearance."

If more than one group is to work on any circuit or equipment, the Contractor's personnel in charge of each group shall have a separate set of locks/tags completed and properly attached. The Government Representative

(COTR, Inspector, Construction Manager), may request and shall be given a separate lock/tag stub). Any Contractor personnel required to enter an area protected by a lock/tag shall be considered a member of the protected group, provided the holder of the lock/tag stub is notified each time the employee enters and departs from the protected area.

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was locked/tagged shall turn in his signed lock/tag stub to the LaRC Safety Operator concerned. The LaRC Safety Operator may then remove the locks/tags. If a lock/tag from a Contractor must be removed in the interest of the Government and the Contractor is not on the job, the LaRC Inspector, with approval of the Office of Safety and Facility Assurance, will coordinate the locks/tags removal and inform the Contractor. The LaRC Inspector will prepare a letter describing in detail the reasons and conditions requiring this method of removal. The letter shall include the contract number, date and time. Copies shall be forwarded to the LaRC Safety Manager and the Contracting Officer Technical Representative (COTR) within 48 hours. The system shall be secured upon the Contractor's return and prior to continuation of the contractual effort.

Before clearance can be given on electrically operated equipment, the circuit or circuits shall be secured in a deenergized condition as described in LAPG 1710.10, "Safety Clearance Procedures (Lockout/Tagout)."

Before clearance can be given on mechanical or fluid systems, the apparatus, valves, or systems shall be secured in a safe condition as described in LAPG 1710.10, "Safety Clearance Procedures (Lockout/Tagout)."

1.6 ELECTRICAL SAFETY

1.6.1 General Electrical Safety Requirements

Before commencing work on any mechanical equipment or systems, which have electrical connections or contain combustible, or other dangerous gases or fluids, such equipment shall be properly grounded, and/or made safe in accordance with LaRC safety regulations concerning these materials. No work (other than performing routine electrical tasks such as taking electrical measurements, replacing plug-in components, or changing fuses) shall be performed on energized power circuits without prior approval of the Contracting Officer.

Only qualified electrical people shall perform the work. If work is planned to be performed on energized circuits, the Contractor shall submit to the Contracting Officer a written application defining the procedure(s) to be used, for approval. Work shall not proceed until approval is received.

The buddy system, a second qualified electrical person directly observing the operation, is mandatory whenever electrical work (including measurements) is to be performed on energized circuits of 601 volts (phase-to-phase) or higher except as follows:

- o A properly instructed person may accompany electrical personnel in lieu of a qualified electrical person when work such as switching or locking/tagging is being performed.

- o A qualified electrical person may be authorized by their line

supervisor to take meter readings without the presence of a second person.

A properly instructed electrical person shall be present when non-electrical work such as groundskeeping is being performed in an energized substation.

Safety glasses or goggles shall be worn when making electrical measurements, inspecting internal wiring of panels, or working with tools in proximity to any energized power circuits. Safety glasses or goggles shall be worn when performing other types of electrical work including control modification and/or checkout.

Do not rely on identification markings on building light and power distribution panels, circuits, and components for establishing safe work conditions.

Ground wires or connections to frames or cases shall not be removed from any energized equipment.

Earth return is not to be used in the wiring of any power circuit.

Temporary electrical wiring shall be supported by suitable wood or other insulating materials.

Temporary electrical wiring and portable electrical cords shall be kept out of water at all times unless the cable is approved by the NEC for that purpose.

When fishing a conductive tape or wire through a conduit, personnel shall be stationed to prevent the free ends of the tape or wire from contacting energized equipment.

All portable electrical tools (except battery operated) shall have ground-fault protection.

The cases of all portable electrical motor-driven hand tools shall be grounded by use of standard three-prong plugs and receptacles and all other electrical equipment supplied with 50 volts or above shall have their cases or frames connected to ground, except:

- Devices operated solely from self-contained batteries.
- Devices that have cases and all exposed parts protected by insulating material.
- "Double insulated" tools.
- Devices supplied with less than 150 volts to ground for which exceptions have been granted by the Office of Safety and Facility Assurance.

Commutating type tools or double insulated tools shall not be operated in proximity to volatile materials.

Welding or burning shall not be permitted in the immediate vicinity of electrical equipment unless specifically authorized by the Contracting Officer.

Only devices designed for voltage testing and rated for the nominal voltage of the circuit under test shall be used to make voltage checks. The Contractor shall verify test voltage indicators immediately before and after use by application to an energized circuit or by using an appropriate test unit.

Only fiberglass or wood ladders shall be used near electrical hazards. Metal ladders shall be marked with signs or decals reading CAUTION--DO NOT USE NEAR ELECTRICAL EQUIPMENT. Ladders shall be clean and in good condition.

When possible, personnel shall stand to the side away from the door/cover when operating (energizing or de-energizing) disconnect switches.

Portable electrical hand tools shall be unplugged when not in use.

Before maintaining or repairing any electrical equipment, the equipment shall be disconnected from the power source.

Equipment that has frayed cords or three-wire cord ends that have had the grounding prong removed shall not be used. Qualified electrical personnel shall repair faulty equipment and tools.

1.6.2 Special Electrical Safety Requirements

1.6.2.1 Equipment Safety Tests and Checks

The following tests shall be performed prior to energizing electrical equipment for the first time:

- o Initial energizing of all electrical equipment shall be performed in the presence of the Contracting Officer.
- o All power feeder circuit breakers shall be checked for proper adjustment and operation in accordance with the manufacturer's instructions. Molded case circuit breakers without solid state trip devices are excluded from this requirement.
- o All wiring shall be field verified for conformity to the design, fabrication, and functional requirements.

1.6.2.2 High Voltage Insulation Testing of Electrical Equipment

High voltage dielectric testing shall be preceded by the following actions:

- o Lockout/tagout the applicable circuits.
- o Secure the area.
- o Perform a low voltage dielectric test (Megger test).
- o Perform grounding procedures.

These tests shall be in accordance with Section 6, Paragraph 6.9 of ANSI/IEEE 95-1977.

1.6.2.3 Rules Governing Contractor Connection Into Government Electrical Utilities

Prior to connecting into any part of the Government electrical power distribution system, the Contractor shall:

- o Make written application to the Contracting Officer stating the date time, location, and the service desired.

- o Jointly with the Contracting Officer, make the necessary checks of the Contractor's system and the Government's supply to assure their compatibility and safety.

1.6.2.4 Switching

All electrical switching that is required for clearance to work on equipment operating from electrical circuits shall only be performed by Government personnel who have been authorized as LaRC Safety Operators for the specific equipment.

1.6.2.5 Removal of Electrical Equipment and/or Wiring

When equipment is designated to be permanently removed, the electrical wiring, conduit, enclosure, and control boxes shall be removed back to the source of feed, unless otherwise noted. Where practicable, the power source shall be deenergized and disconnected prior to disconnecting the load or cutting the cables.

1.7 PAINTING AND COATING OPERATIONS

The Contractor shall protect all adjacent materials and equipment against damage from spillage, dripping and spatter of coating materials. All building materials and equipment shall be left clean, with all damaged surfaces corrected. Provide "WET PAINT" signs to indicate newly painted surfaces.

The Contractor shall provide adequate ventilation for all interior spaces during application and drying of coatings, to prevent the build-up of toxic or explosive concentrations of solvent vapors.

1.8 ROOFING AND COATING OPERATIONS

At the beginning of each workday, Contractors performing roof repairs or modifications shall check with the Contracting Officer to assure safe work conditions before proceeding to work on the roof, if required by the Contracting Officer.

All accesses to hazardous roof areas shall be identified by the appropriate warning signs.

All personnel requiring access to roof areas shall notify the Contracting Officer and obtain approval prior to performing any roof activity.

Where structural integrity or permanent safety devices do not provide sufficient protection, special security, safety equipment and/or procedures, and temporary structural requirements shall be implemented.

Where access to roof-located equipment can be anticipated (for example, heating, ventilation, and air-condition (HVAC), the following apply:

- o The Contractor shall provide permanent working platforms, associated walkways or ladders, and appropriate rails and guards in accordance with OSHA regulations.

- o The Contractor shall identify and certify those workers requiring access shall be identified and certified as "high workers."

- o Code compliant safety equipment and procedures shall be established for these operations.

For buildings with adequate structural integrity, the same requirements described above apply to roof repair or modification. Roof activities on surfaces that are structurally inadequate, or which are not permanently configured for such work, may have additional requirements.

Routes clear of obstructions shall be provided for all persons carrying hot substances.

The carrying of hot substances up and down ladders is prohibited.

Hoisting gear used in handling hot substances shall be adequate for the loads imposed and shall be securely and substantially braced and anchored.

1.9 FIRE PREVENTION AND PROTECTION

1.9.1 General Requirements

Fire prevention and protection shall be in accordance with NASA-STD-8719.11, "NASA Safety Standard for Fire Protection".

All hot work shall have a "Hot Work Permit" issued by the Fire Department. Hot Work will not be permitted until a Hot Work Permit has been issued and posted. Deviations or waivers from this and the following requirements must be presented to the LaRC Fire Chief, in writing, for review and consideration. Only the LaRC Fire Chief can grant deviation or waiver approval.

1.9.2 Welding, Flame Cutting and Melting

All welding and cutting operations including, but not limited to, the use of acetylene and propane torches, heat guns, grinders, electric arc welders, and activities such as brazing, shall be done in accordance with the publications of the American Welding Society, and the National Fire Protection Association NFPA 51 and NFPA 51B, Chapter 22 of the "Virginia Statewide Fire Prevention Code".

1.9.3 Prohibitions

Hot work activities shall not be performed on the following:

- o Combustible walls or ceilings or those containing combustible insulation.

- o Tanks or pipes that have held flammable liquids, (unless they have been thoroughly purged and tested for residual vapors).

- o Pipes or other metal in contact with combustible materials if ignition of material is possible due to conduction.

- o Metal partitions, walls, ceilings, or roofs having a combustible covering.

- o Walls or partitions of combustible sandwich-type panel construction.

- o Automatic sprinkler systems after initial installation of systems have been completed.

1.9.4 Safeguards

- o Contractor shall remove flammable liquids, oily deposits, and combustible materials within 35-feet of the hot work area.

- o Contractor shall cover or shield combustible materials that cannot be removed with flameproof covers, fire resistant guards, or fire resistant curtains.

- o Contractor shall cover cracks in walls, floors, ducts, or other concealed spaces within 35-feet of the hot work area to prevent the passage of sparks or slag to adjacent areas.

- o Prior to beginning hot work, Contractor shall remove combustible materials from the opposite side of walls, partitions, ceilings or roofs.

- o Nearby personnel shall be protected from heat, sparks, and/or slag, through the use of fire resistive screens or shields.

Special precautions, as recommended by the LaRC Fire Chief and approved by the Contracting Officer, shall be taken to avoid unwanted activation of automatic detection or suppression systems due to the use of hot work equipment.

1.9.5 Firewatch

The Contractor shall assign a firewatch for every job involving hot work. The firewatch personnel shall not have any other collateral duties to distract or occupy them.

The firewatch personnel shall know the location of fire alarm pull stations in the work area and shall have two fully charged, 10-pound, ABC multi-purpose, dry chemical fire extinguishers available at all times. Facility fire extinguishers shall not be used to satisfy this requirement. The firewatch personnel shall be qualified in the proper use of fire extinguishers for controlling or extinguishing incipient fires.

The firewatch personnel shall continuously monitor the work area for any smoldering fires or hot spots during the period the hot work is being conducted, and for a period of 30 minutes following the termination of the hot work operation. The firewatch personnel shall immediately notify other workers if any dangerous conditions develop, and call the LaRC Fire Department, at 911 on Center telephones or 864-2222 on cellular telephones.

1.9.6 Means of Egress

An unobstructed means of egress in accordance with NFPA 101, "Life Safety Code," shall be maintained at all times, for use by construction workers and LaRC employees.

1.9.7 Fire Protection and Detection Systems

During building alterations and modifications, where the building is protected by fire detection and/or protection systems, such systems shall be maintained in an operable condition at all times. Shut down for any reason shall be pre-approved and coordinated with the LaRC Fire Chief or designee.

If it is necessary to place any existing fire detection or protection system out of service, temporary protection measures such as the termination of all hazardous operations, or frequent inspections of the area involved with a 24-hour per day firewatch may be required by the LaRC Fire Chief or designee.

The Contractor shall make regular checks on the fire sprinkler, and standpipe control valves will be regularly checked at the end of each work period to ascertain that such systems are in service.

If fire sprinkler heads are located within a demolition area, all heads subject to physical damage shall be fitted with guards.

If smoke detectors are located such that dust and/or gases resulting from the construction may adversely affect them, the following procedures shall be adhered to:

- o Place sequentially numbered plastic bags around each smoke detector in the affected area each day before renovation begins.

- o Post manual instructions and inform all Contractor personnel on how to manually signal a fire condition.

- o If the area in question contains a special hazard, an employee of the Contractor shall be dedicated as a firewatch for the period that detectors are bagged.

- o Remove all bags at the end of each work day until renovation work is completed. Bags shall be removed sequentially and recorded, to ensure that every bag is removed.

1.9.8 Portable Fire Extinguishers

The suitability, distribution, and maintenance of portable fire extinguishers shall be in accordance with NFPA 10, "Standard for Portable Fire Extinguishers." The Contractor shall provide and maintain at least one 10-pound, multipurpose dry chemical fire extinguisher in a visible location on each floor of the construction area and at each usable stairway, at all times. The Contractor shall provide and maintain two 4-A, 60-B:C rated fire extinguishers within 25 feet of each asphalt (tar) kettle, during the period such kettle is being utilized, and one additional 4-A, 60-B:C fire extinguisher on the roof being covered. Contractor employees shall be instructed in the proper use of extinguishers.

1.9.9 Temporary Heaters

When open-flame heating devices or other temporary heating equipment are used, the Contractor shall obtain a written permit from the Fire Chief for each use.

- o Temporary heating equipment shall be listed, installed, used, and

maintained in accordance with the manufacturer's instructions.

- o Chimney or vent connectors, where required by direct-fired heaters, shall be maintained at least 18-inches from combustibles and shall be installed in accordance with NFPA 211, "Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances."

- o Oil-fired heaters shall be designed and installed with features in accordance with NFPA 31, "Standard for the Installation of Oil-Burning Equipment."

- o Fuel supplies for liquefied petroleum gas-fired heaters shall be in accordance with NFPA 54, "National Fuel Gas Code," and NFPA 58, "Standard for the Storage and Handling of Liquefied Petroleum Gases."

- o Refueling operations shall be conducted in accordance with NFPA 58.

- o Heating devices shall be secured and shall otherwise be installed in accordance with their listing, including clearance to combustible material, equipment, or construction.

- o Temporary heating equipment, where utilized, shall be monitored for safe operation and maintained by properly trained personnel.

- o All approved by the Contracting Officer, heating equipment shall be provided with safeguards, such that when tilted or tipped over, their power source will be automatically shut off.

- o Temporary burner-type heaters that are in use during other than normal working hours shall have an hourly firewatch provided.

- o Burner-type heaters are not permitted in areas where painting or similar operations may create an explosive atmosphere.

1.9.10 Removal of Combustible Waste Material

The Contractor shall remove accumulations of combustible waste material including, paper/plastic packing and wrappings, scrap lumber, dust, and other construction rubbish from the structure and its immediate vicinity at the end of each work shift or more frequently as necessary for safe operations.

The Contractor shall promptly dispose of materials subject to spontaneous ignition, such as oily waste and rags used with paint, linseed oil or other flammable or combustible liquids. Such materials shall only be placed in noncombustible receptacles with tight-fitting lids that are physically located away from any building or structure.

1.9.11 Disposal of Rubbish

The burning or incineration of rubbish, such as construction debris, brush, or trees is prohibited on LaRC. The Contracting Officer will provide direction as to the appropriate method of disposal.

1.9.12 Flammable and Combustible Liquids

Flammable and combustible liquids shall be stored and handled in accordance with NFPA 30, "Flammable and Combustible Liquids Code."

Open flames and smoking shall not be permitted in flammable and combustible liquid storage areas. Such areas shall be appropriately posted as "NO SMOKING" areas.

Class I and Class II liquids shall be kept in approved safety containers.

Class I liquids shall be dispensed only where there are no open flames or other sources of ignition within the possible path of vapor travel.

Bulk storage of flammable liquids is prohibited unless the LaRC Fire Chief or designee has granted prior approval.

Flammable liquids in quantities of 5-gallons or less shall be transported only in code compliant safety containers.

1.9.13 Smoking

Smoking shall only be permitted in areas designated by the LaRC Fire Chief or designee. Such areas shall be provided with receptacles of non-combustible construction.

1.9.14 Non-Emergency Use of Fire Hydrants

Requests for the non-emergency use of fire hydrants shall be made to the LaRC Fire Chief or designee prior to use. Requests may be approved with the following restrictions:

- The hydrant user shall install one valve on the 4-1/2-inch port on each hydrant to be used. (This 4-1/2-inch port with the valve installed is reserved for LaRC Fire Department use only.)

- One or both of the 2-1/2-inch fire hydrant ports shall be reserved for non-emergency use. The hydrant user shall provide an approved 2-1/2-inch gate valve on one or both of the 2-1/2-inch fire hydrant ports, reduced down to 1-1/2-inches.

1.9.15 Fire Department Access

Main access roadways shall not be obstructed in any manner.

Unobstructed access from the street to fire hydrants and to outside connections for standpipes, sprinklers, or other fire extinguishing equipment, whether permanent or temporary, shall be provided and maintained at all times.

Unobstructed access to the main fire alarm control panel, permanent, temporary, or portable first-aid fire equipment shall be provided and maintained at all times.

1.10 ASBESTOS OPERATIONS

1.10.1 General Requirements

These specifications present criteria for operations involving removal, repair, or other work with asbestos. Asbestos is defined as any material containing more than one- percent asbestos by weight, which is friable during expected handling. All asbestos operations shall be conducted in accordance with Federal, State, and Local regulations applicable to asbestos and including provisions of 40 CFR Part 61 Subpart M, National

Emissions Standard for Hazardous Air Pollution; 29 CFR Part 1926.58 Asbestos; Part 54.1-500 through 1-517 of the Code of Virginia; LAPG 1740.2, Chapter IV, Asbestos; and LAPG 8800.1, Chapter 8, Section 8.3.5 (Environmental Program Manual).

The Contractor shall comply with the Commonwealth of Virginia asbestos handling licensing requirements for contractors, supervisors and workers. The Contractor shall provide a copy of its current asbestos-handling license to the Contracting Officer, prior to beginning on-site operations.

1.10.2 Notification Requirements

Notification of Federal and State regulatory agencies is the responsibility of the contractor involved with the removal/abatement activity.

In work involving pipe or duct insulation of more than 10 linear feet and/or 10 square feet of insulating surfacing material, Contractor notification to the Commonwealth of Virginia is required. Additionally, the Contractor shall notify the Environmental Protection Administration of renovations involving at least 260 linear feet or 160 square feet respectively.

1.10.3 Operational Procedure

The Contractor shall submit an asbestos operational procedure to the Contracting Officer for approval. The procedure shall specify how the Contractor will assure compliance with applicable regulations. The procedure shall include attention to the following elements as appropriate to the specific job:

- o A work schedule including start and anticipated finish dates
- o Work area control procedures
- o Personal protective equipment and clothing to be worn
- o Work practices to be observed
- o An air monitoring plan
- o Personal hygiene procedures
- o Labeling
- o Asbestos waste handling and disposal procedures, including a description of the waste and an estimate of volume to be generated

1.10.4 Disposal of Asbestos Waste

Asbestos removed from LaRC removal/abatement sites remains Government property throughout the removal activity and should be processed as such on the Waste Shipment Record.

Disposal of asbestos waste is the responsibility of the Contractor performing the removal/abatement activity. The Contractor shall follow 40 CFR Part 61, Subpart M and Chapter 8, Section 8.3.5, Asbestos Removal/Abatement Contractor of the Environmental Program Manual, and all Federal, State and Local regulations applicable. Transportation of asbestos material off-site shall be in accordance with Department of

Transportation Regulations (40 CFR Part 173.1090).

Upon request, the Contractor may use an on-site staging area provided by the Government. The Contractor is responsible for the transportation of the properly packaged asbestos waste to the staging area. The Government will provide timely notification to the Contractor, of the location of the on-site staging area to be used for the accumulation of asbestos waste.

The Contractor shall provide a properly prepared waste shipment record which complies with 40 CFR Part 61.150 (d), two days prior to pickup, for the disposal of all Regulated, Asbestos-Containing Material (RACM), which:

1. Identifies NASA, Langley Research Center as owner and waste generator. Address of waste generator shall be:

   NASA, Langley Research Center
   Office of Environmental Management Office, MS 418
   Hampton, VA 23681
   Telephone: (757) 864-3394

2. Contains name and address of the local, State or EPA Regional Office responsible for administering the asbestos NESHAP program. Address of responsible agency shall be:

   Commonwealth of Virginia Department of Air Pollution Control
   P.O. Box 10089
   Richmond, VA 23240

3. Contains the name and telephone number of the contractor responsible for the removal of asbestos at the building site.

4. Contains the approximate quantity in cubic meters and in cubic yards.

5. Contains the name and physical site location of the State-approved landfill disposal site.

6. Contains the name, address, and telephone number of the transporter(s).

7. Includes the date transported.

8. Shall be signed by a NASA official in the Environmental Management Office only after completion of all information in Items 1 through 7 above.

1.10.5 Submittals

The Contractor shall provide the following submittals as required herein, by Section 01330 of these specifications, and by applicable law and regulations as cited above:

- o A copy of the Contractor's current asbestos handling license issued by the Commonwealth of Virginia.

- o Written proof of required notifications to the Commonwealth of Virginia and the EPA as may be appropriate.

- o Written asbestos waste handling and disposal procedure.

- o Signed certification statement from off-site transporter of asbestos.

- o A copy of the waste shipment record signed by the owner of the disposal facility indicating receipt of asbestos waste by the initial transporter. This copy shall be received by the generator within 35 days of the date the RACM was accepted by the transporter.

1.10.6 Monitoring Requirements

The Contractor shall be responsible for all personnel monitoring. For projects plus or minus 1,600 square feet or plus or minus 2,600 linear feet the Contractor shall provide an on-site Virginia licensed Project Monitor to conduct personnel monitoring.

1.10.7 Final Clearance

Final visual inspection and final clearance air sampling will be conducted by the Government Industrial Hygienist. Final clearance air sampling will be performed after no visible dust, debris or other material is observed during the final visual inspection. Final clearance will be granted when fiber concentrations are found to be plus or minus 0.01 f/cl (pcm) or average 70 structures/mm2 (TEM).

The cost of the initial final clearance air samples will be paid by the Government. If final clearance is not obtained, the Contractor shall re-clean the work area at no additional cost to the Government.

1.11 USE OF EXPLOSIVES

The use of explosives is not permitted.

1.12 FALL PROTECTION (OSHA 29 CFR PART 1926.500 THROUGH 1926.503)

Fall protection devices and systems shall be in accordance with OSHA 29 CFR Part 1926.500.

The Contractor shall provide fall protection devices and systems for employees in accordance with OSHA 29 CFR Part 1926.501, when working at a height greater than 6 feet.

Body belts are not acceptable as part of a personal fall arrest system. Personnel shall use a full body harness with shock absorbing lanyard.

1.13 LIFTING OPERATIONS

1.13.1 General

Only capable and experienced riggers and equipment operators shall be engaged in on-site lifting operations. In establishing the qualification of such riggers and equipment operators, it is essential that such personnel be knowledgeable about and capable of: determining center of gravity (C.G.) of items to be lifted; determining load weights; calculating lifting line strengths and the margins of safety; calculating sling tension loads; using common slings and hitches; selecting proper sizes and the use of chocks; using hydra-sets; using proof loading specifications; use of hand signals; using and determining strength of knots; using and determining strength of shackles/hooks; and the factors causing distortion of loads (blocking). Personnel involved in these operations shall have at least four years experience in such efforts.

Certification Letter for Operators of Non-Government Owned Lifting Equipment
The Contractor shall provide a certification letter to the Contracting Officer listing all qualified riggers and equipment operators who will be working on-site stating; (1) their years of experience, (2) specialized training, and (3) medical qualifications, (i.e., any visual, hearing, or other physical limitations). This letter shall be submitted to the Contracting Officer prior to on-site lifting operations.

If lifting operations are being conducted in an unskillful manner, the Contracting Officer may, in accordance with FAR Clause 52.236-5, Material and Workmanship, require the Contractor to remove any employee failing to follow appropriate procedures.

1.13.2 Lifting Devices

All Contractor-furnished lifting devices used on-site shall meet the minimum requirements of the applicable ANSI specifications incorporated in OSHA, 29 CFR Part 1926/1910, Subpart N.

All mobile/truck-mounted cranes must have a current annual inspection and "Certification of Load Test". The Certification must be kept on the crane and be made available for inspection by the NASA Inspector or the Office of Safety and Facility Assurance Representative upon request. The Office of Safety and Facility Assurance shall be notified prior to any mobile/truck mounted crane being brought onto LaRC, at 864-5594 or 864-7233.

The Contracting Officer may inspect at any time, any or all of the Contractor-furnished lifting devices used on-site. If any of the devices do not meet the above requirements, they will be barred from further use until all necessary repairs have been made and they have been reinspected.

Where cranes and derricks are used in or around high-voltage substations, overhead lines, or exposed energized parts, the operations and equipment shall be in accordance with OSHA Subpart N, Paragraph 1926.550, "Cranes and Derricks."

All lifting equipment shall be effectively grounded when being moved or operated in proximity to energized lines or equipment. Consideration shall also be given to grounding the load, particularly if insulated lifting straps are in use.

Lifting equipment shall be operated with a dedicated observer to warn the equipment operator of potentially hazardous situations and/or movements.

1.14 ACCIDENTS AND SAFETY RELATED INCIDENTS

1.14.1 Emergency Response and First Aid Facilities

Contractor employees working onsite may use the Occupational Medical Center for emergency first aid. This facility is located in Building 1149 at 10 West Taylor Street. The telephone number is 864-3196.

To facilitate the rapid notification of emergency responders in the event of a fire, injury or other hazardous conditions, it is recommended the Contractor have a telephone available at the job site.

Emergency response may be obtained by dialing 911 from any Center telephone or by dialing 864-2222 from cellular telephones.

The Contractor shall assure that its personnel are aware of these emergency first aid and emergency response services and shall post the above information conspicuously at the job site.

Accidents shall be reported to the NASA LaRC Safety Office at 864-7233 as soon as possible. A written report of the accident shall be filed with the NASA LaRC Safety Office within 3 working days after the accident.

1.14.2 Accident Reporting

All near miss/close call accidents occurring on the Center involving NASA property or equipment, shall immediately be reported to the NASA LaRC Safety Office at 864-7233.

A near miss/close call accident is defined as a work-related accident that could have caused an injury or property/equipment damage.

1.15 DISPOSAL OF HAZARDOUS WASTE MATERIAL

Disposal of hazardous waste shall be conducted in accordance with RCRA and Federal regulations, State regulations (VR 672-10-1), and LAPG 8800.1, Chapter 5 (Environmental Program Manual). The Government will be responsible for disposal of all hazardous/regulated waste. Any waste generated by the Contractor at the construction site shall be reported to the Contracting Officer to determine if the waste is regulated or hazardous. The Contractor shall not generate hazardous/regulated waste until it has received written approval and been informed of all applicable regulations concerning the waste generated, by the Environmental Management Office (EMO). The Contractor will be audited by the Environmental Management Office to assure that all RCRA regulations and proper hazardous waste practices are being followed. Contractor shall take appropriate actions to assure compliance with all Hazardous Waste regulations. The Contracting Officer shall be advised of all waste disposal practices at the construction site and will be the liaison between EMO and the Contractor.

Disposal of hazardous waste into the storm or sanitary sewer is prohibited at all times. Disposal of non-hazardous wastes into sewer systems is authorized only after approval by the Contracting Officer. A permit issued by EMO is required before these waste practices can be permitted. The permit form is Attachment 2 to this section.

1.16 PERSONAL PROTECTIVE EQUIPMENT

Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in accordance with OSHA 29 CFR Part 1926, Subpart E, wherever it is necessary by reason of hazards, processes, environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

1.17 SIGNS, SIGNALS AND BARRICADES

1.17.1 Accident Prevention Signs

Contractor shall place signs at locations where hazards exist, as described below. These signs shall be visible at all times when work is being performed and shall be removed or covered promptly when the hazard(s) no

longer exists. (OSHA 29 CFR Part 1926.200)

Danger signs shall be used where an immediate hazard exists. Caution signs shall be used to warn against potential hazards or to caution against unsafe practices.

Safety instruction signs shall be used to identify safety requirements relating to the work (e.g., Hard Hats Area, Eye and Hearing Protection Required). Contractor shall post construction areas with legible traffic signs at points of hazard. All traffic control signs or devices used for protection of construction workmen shall conform to American National Standards Institute D6.1-1971, Manual on Uniform Traffic Control Devices for Streets and Highways.

1.17.2 Signaling

When operations are such that signs, signals, and barricades do not provide the necessary protection on or adjacent to a roadway, flagmen or another appropriate traffic control shall be provided. Signaling directions by flagmen shall conform to American National Standards Institute D6.1-1971, Manual on Uniform Traffic Control Devices for Streets and Highways.

1.17.3 Barricades

Barricades shall be used to deter the passage of persons or vehicles from a hazard, such as openings in walls, floors and roof edges. Barricades shall conform to the portions of the American National Standards Institute D6.1-1971, Manual on Uniform Traffic Control Devices for Streets and Highways, relating to barricades. (OSHA 29 CFR Part 1926.202)

1.18 HAND AND POWER TOOLS

All hand and power tools and similar equipment shall be maintained in a safe condition. When power operated tools are designed to accommodate guards, they shall be equipped with such guards when in use. (OSHA 29 CFR Part 1926.300)

Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains, or other reciprocating, rotating or moving parts of equipment shall be guarded if such parts are exposed to contact by employees or otherwise create a hazard. Guarding shall meet the requirements as set forth in American National Standards Institute, B15.1-1953 (R1958), Safety Code for Mechanical Power-Transmission Apparatus.

1.19 SCAFFOLDING

All scaffolding activities shall be in accordance with OSHA 29 CFR Part 1926.451.

1.20 STEEL ERECTION

All steel erection activities shall be in accordance with OSHA 29 CFR Part 1926.750 through 1926.752.

1.21 CONCRETE AND MASONRY CONSTRUCTION

All concrete and masonry construction shall be in accordance with OSHA 29 CFR Part 1926 Subpart Q.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

REHABILITATION OF BUILDING 1247H FOR THE 2' X 3' LOW SPEED TUNNEL

Safety Program Guide
Items That Must Be Addressed
(Unless Totally Inapplicable) On All Safety Plans

Contract Identification - Job title and contract number and a brief summary and scope of the work. The safety representative shall be identified.

Accident Reporting - All accidents shall be reported (as soon as possible) to the NASA LaRC Safety Office at 864-7233. A written report of the accident shall be filed with the NASA LaRC Safety Office within 3 working days after the accident.

Recordkeeping - The Contractor shall maintain the appropriate records concerning accidents and injuries, in accordance with OSHA 29 CFR 1904.

Flammable Liquid Storage Containers - Flammable liquids shall only be stored in code compliant flammable liquid safety cans that have self-closing spouts.

NASA LaRC Lockout/Tagout System - All contractors/subcontractors shall comply with the NASA LaRC Lockout/Tagout system when performing work on-site, as described in LAPG 1710.10, "Safety Clearance Procedures (Lockout/Tagout). Under no circumstances shall a NASA LaRC Lockout/Tagout device be violated.

Safety Regulations - In addition to OSHA and Federal Regulations, the Contractor shall adhere to all applicable State, Local and Langley Research Center Safety Regulations.

Confined Space Entry - Confined spaces shall not be entered until a Confined Space Entry Permit has been obtained. The Contractor shall have personnel trained in confined space entry, shall provide the permit and conduct initial and hourly readings as required by OSHA 29 CFR 1910.146.

Crane Certification - All mobile/truck-mounted cranes shall have a current "Annual Certification of Load Test". The Certification shall be kept on the crane and be made available for inspection by the NASA Inspector or the Office of Safety and Facility Assurance Representative upon request. The Office of Safety and Facility Assurance shall be notified immediately when any mobile/truck mounted crane is brought onto the Center, at 864-5594 or 864-7233.

Scaffolding - When scaffolding is required, it shall be designed, constructed and assembled in accordance with OSHA 29 CFR 1926.450 through 454.

Excavations and Trenching - Surface penetrations of 6 inches or more require a "Digging Permit" and shall follow all applicable standards under OSHA 1926.650-652.

Material Safety Data Sheets (MSDS) - A MSDS shall be available for material including, but not limited to, each chemical, oil, lubricant, solvent, or other material used on the job-site.

Fall Protection - When fall protection is required, the Contractor shall comply with OSHA 29 CFR 1926.500 through 1926.503, which defines the types of

fall protection devices and systems. Personnel shall use a full body harness with shock absorbing lanyard.

SECTION 01060, ATTACHMENT 1

Extension Cords and Ground Fault Protection - All extension cords shall be the three wire grounded type and be in good working order (No broken or missing pins). Extension cords or other temporary wiring shall be protected by a Ground Fault Interrupt (GFI) device.

Subcontractor Compliance - All subcontractors shall comply with the Prime Contractor's Safety Plan.

Safety Meetings - The Contractor shall hold weekly "tool box" safety meetings.

Hazardous Communications Program - The Contractor shall furnish a copy of his hazardous communications program as defined in CFR 29 Part 1910.1200.

Floors, Openings - Unprotected openings in walls, floors or roof edges shall be guarded using standard handrails, barricades, or equivalent protection.

Steel Erection - When steel erection is required, it shall be performed in accordance with OSHA 29 CFR 1926.750 through 1926.752.

Personal Protective Equipment - When required, the appropriate PPE shall be used in accordance with OSHA 29 CFR 1926 Subpart E.

Hot Work Permit - Hot Work will not be permitted until a Hot Work Permit has been issued by the Fire Department, approved and posted. Deviations or waivers from this and must be presented to the LaRC Fire Chief, in writing, for review and consideration. Only the LaRC Fire Chief can grant deviation or waiver approval.

REHABILITATION OF BUILDING 1247H FOR THE 2' X 3' LOW SPEED TUNNEL

SECTION 01060, ATTACHMENT 1

REHABILITATION OF BUILDING 1247H FOR THE 2' X 3' LOW SPEED TUNNEL

SEWER DISPOSAL PERMIT

PART ONE (TO BE COMPLETED BY REQUESTOR)

1. Name of material_____

2. Quantity_____

3. Date(s) of proposed disposal_____

4. Analytical Data: MSDS___ Laboratory Analysis___ Attached___ (Check at least one)

5. Sanitary Sewer_____ Storm Sewer_____

6. Signature of Requestor_____

7. Organization_____

8. Date_____

PART TWO (TO BE COMPLETED BY THE ENVIRONMENTAL MANAGEMENT OFFICE)

Authorization for disposal of the material described above is granted. Any deviation invalidates this permit.

_____ _____

Environmental Management Office Date

REHABILITATION OF BUILDING 1247H FOR THE 2' X 3' LOW SPEED TUNNEL

SECTION 01060, ATTACHMENT 2

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01330

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PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01330

SUBMITTALS

PART 1 GENERAL

1.1 SUMMARY

This section defines and explains the general submittal requirements applicable to all submittals under this contract. Specific submittals required are set forth by the various administrative or technical sections of this specification, the contract drawings, or other portions of this contract. Accordingly, the Contractor shall make timely and complete submittals as required by all applicable contract provisions.

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTAL PREPARATION AND CONTENT

1.2.1 Technical Submittals

All technical submittals, for action of the Contracting Officer, shall be submitted on the Langley Technical Submittal Form (see Attachment 1). The actual transmittal form for this project will be transmitted to the Contractor at the time of Notice to Proceed.

The technical submittal form shall serve as the Contractor's cover sheet and also the Government's approval/review sheet back to the Contractor.

The Contractor shall submit one technical submittal form cover sheet for each package of submittals.

Technical submittals shall be grouped by specification section and shall be limited to eight (8) submittals from one specific specification section per sheet.

Item number, specification section and paragraph number, SD number and description shall be completed for each item submitted.

The Contractor shall note any specification deviation included in the submittal package.

1.2.2 General

All submittals shall be in the English language.

Submittals become the property of the Government. The Government reserves the right to duplicate, use, and disclose, in any manner and for any purpose, shop drawings delivered under this contract. Wording such as "Confidential", "Do not reproduce", and similar statements shall not be included on the submittals. Submittals that prohibit duplication will be returned to the Contractor for correction and resubmitting. Refer to FAR 52.236-21, Performance of Work by the Contractor, for additional information.

Variations of submittal items from contract requirements shall be specifically pointed out in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

The Contractor shall allow 30 calendar days for review of submittals. If the Contractor deems a submittal critical or urgent (e.g., to order long lead-time items; enter into firm subcontracts or supplier purchase orders), it shall so state on the letter or form transmitting such submittal and shall indicate its priority for the items submitted.

The Contracting Officer will, after receipt of submittals, return one copy to the Contractor marked "Reviewed", "Approved," "Approved with corrections as noted," "Reviewed with corrections as noted," or "Returned for corrections," which shall be interpreted as follows:

Submittals marked "Reviewed" authorize the Contractor to proceed with the work covered by such submittals.

Submittals marked "Approved" authorize the Contractor to proceed with the work covered by such submittals.

Submittals marked "Approved with corrections as noted" or "Reviewed with corrections as noted," authorize the Contractor to proceed with the work covered by such submittals in accordance with the corrections indicated thereon. The Contractor shall make the corrections to the submittals and resubmit them within fifteen calendar days after receipt of the marked submittals.

Submittals marked "Returned for correction" require the Contractor to make the necessary corrections and revisions to the submittals and to resubmit them for approval.

Where the submittal is for Information, the Government may indicate recommended corrections, or take no action, at its discretion. The Contractor may proceed with the work without response from the Government.

Government review or approval does not relieve the Contractor of responsibility for the accuracy and correctness of submittal data furnished or for compliance of the submittal's subject items with all applicable contract requirements.

Where Review of the submittals is indicated, the Government will notify the Contractor of any recommended corrections within 30 calendar days after receipt. If the Government takes no action within 30 calendar days, the Contractor may assume Government acceptance and proceed with the work.

Where Approval of submittals concerning materials, drawings, or other submittals is required prior to work execution, the Contractor shall not proceed with the affected work until such approval is received from the Contracting Officer. Government action will be taken within 30 calendar days.

Partial Submittals will not be accepted for expediency of the contract's completion.

1.2.3 Calculations, Drawings, Data, and Other Contractor Submittals

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical.

1.2.3.1 Calculations and Drawings

As required by the various sections of these specifications, the Contractor shall prepare all calculations and/or drawings to fabricate, assemble and install all parts of the work, in such detail that will enable the Contracting Officer to understand and check conformity with the contract specifications.

Copies of the calculations and computations shall be submitted in booklet form, arranged to show electrical, mechanical, and structural/architectural divisions.

When action is taken by the Contracting Officer, each copy of drawings/calculations will be identified as having received such action by being so stamped and dated. The Contractor shall make any corrections required by the Contracting Officer. If the Contractor considers any correction indicated to constitute a change to the contractual requirements, it shall promptly notify the Contracting Officer and shall not proceed with the work covered thereby until directed to do so. The Contractor shall be responsible for the complete accuracy of the dimensions and design of adequate connections, and details, and satisfactory construction of all work.

The drawings shall be made by such a methods and be of such quality of workmanship to permit the making of legible reproductions and revisions without impairing their usefulness. Drafting standards (electrical / controls drafting standard SEC/PECSB) employed shall permit reducing the drawings to a 35mm negative from which a full size enlarged print can be reproduced without loss in resolution of the information contained thereon. The drawings shall be made on translucent sheets, not less than 8-1/2 by 11 inches in size, not larger than 22 by 34 inches in size, except for full size patterns or templates. Shop drawings shall be prepared to accurate size, with scale indicated, except where other form is required. All drawings shall be prepared in AutoCAD Version 14 format or later using conventional symbols recognized in the applicable standards referenced in the specification. All drawings shall be signed by a responsible representative of the Contractor.

Drawing reproducibles shall be suitable for microfilming and reproduction on Diazo or Ozalid machines and shall be of a quality to produce clear, distinct lines and letters. Drawings shall have dark lines on a white background.

Copies of each drawing shall have the following information clearly marked thereon:

a. The job name, which shall be the general title of the contract drawings.

b. The date of the drawings and revisions.

c. Name of Contractor.

d. Name of Subcontractor and/or manufacturer.

e. The name of the item, material, or equipment detailed thereon.

f. The number of the submittal (e.g., first submittal) in a uniform location adjacent to the title block.

The Contractor shall submit drawings in a sequence that will permit the work to proceed in an orderly manner consistent with the sequence of events as scheduled on the Contractor's scheduling technique required by this contract.

1.2.4 Submittal Descriptions (SD)

Submittal Description (SD): These are drawings, diagrams, layouts, schematics, catalog cuts, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the contractually required work.

The following items are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each specification section.

SD-01 Data

General:

Submittals which provide calculations, descriptions, or other documentation regarding the work.

Manufacturer's Catalog Data:

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

Manufacturer's Standard Color Charts:

Printed illustrations displaying choices of color and finish for a material or product.

Design Data:

Design calculations, mix design analyses, or other data pertaining to a part of the work.

Recertification Status Sheets:

Tabular summary of component data including: end connections, manufacturer, description, material, installation date, allowable working pressure, and code compliance.

SD-04 Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work. Drawings may include the types of graphically depicted information discussed below.

Control Diagrams, Connection Diagrams and Schematics shall be drawn on Government furnished 22-by 34-inch plastic drafting film with standard Langley Research Center title blocks. The diagrams shall be coordinated with the wiring diagrams of the equipment furnished under sections of Division 15 and Division 16. Prior to final payment on this contract, the "as-built" original tracings of the control diagrams, including electronic files in AutoCAD format, shall be forwarded to Langley Research Center for retention.

Connection and Wiring Diagrams

Connection diagrams shall indicate the relations and connections of devices and apparatus. They shall show the general physical layout of all controls, the interconnection of one system, or portion of system, with another, and all internal tubing, wiring, and other devices.

Control Diagrams

Control diagrams shall show the physical and functional relationship of equipment. Electrical diagrams shall show size, type, and capacity of the systems. Pneumatic diagrams shall be furnished where air or gas systems are used.

Elementary Diagrams

Elementary diagrams shall indicate, in straight-line form, without regard for physical relationship, all supporting systems and elements of equipment and associated apparatus.

Interconnection Diagrams

Interconnection diagrams shall indicate, to scale, interface between associated units of equipment and between equipment and systems.

Schematics

Schematic drawings shall depict the functional flow of systems and their interfaces with facilities and other systems. Functional and physical interfaces shall be indicated. Schematics need not be to scale. Schematics may be structural, mechanical, electrical, or a combination of these.

Fabrication/Erection/Installation Drawings

Fabrication, erection, installation, and checkout drawings and specifications shall indicate equipment arrangement, with elevations, sections, and enlarged details. Details shall indicate proper methods of fabrication, construction, and installation.

As-Built Drawings

As-built drawings shall provide current factual information including deviations from, and amendments to the drawings and changes in the work, concealed and visible.

Pressure Systems Drawings:

Pressure systems drawings shall be an isometric depiction of the

pressure piping system as installed. The drawing shall include all system components, each uniquely numbered, including supports and all other specific elements which represent the as-built configuration. Component numbering shall be continuous throughout the system.

SD-06 Instructions

Preprinted material describing installation of a product, system, or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

SD-07 Schedules

Tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

SD-08 Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other subcontractor, to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications, or other verification of quality. This shall include plans or other documentation to ensure compliance with local, state, and federal safety laws and regulations.

SD-09 Reports

General:

Reports of inspections and/or laboratory tests, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

Test Reports:

A report signed by an authorized official of a testing laboratory that a material, product, or system identical to the material, product, or system to be provided has been tested in accordance with requirements specified by naming the test method and material. The test report must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. Testing must have been within 3 years of the date of award of this contract.

Factory Test Report:

A written report which includes the findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for this project before it is shipped to the job site. The report must be signed by an authorized official of the manufacturer or an independent testing laboratory and must state the test results. The report shall also indicate whether the material, product, or system has passed or failed the test. These reports shall be subject to approval of the Contracting Officer, unless otherwise specified herein, before delivery of the materials or equipment. This approval shall not relieve the Contractor of the obligation to meet all

the requirements of the contract.

Field Test Report:

A written report which includes the findings of a test made at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation. The report shall be signed by an authorized official of a testing laboratory or agency, must state the test results, and indicate whether the material, product, or system has passed or failed the test.

SD-13 Certificates

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meets specified requirements. The statements must be dated after award of contract, name the project, and list the specific requirements.

SD-14 Samples

General:

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

Color Selection Sample:

Samples of the available choice of colors, textures, and finishes of a product or material, presented over a substrates identical in texture to that proposed for the work.

Sample Panels:

An assembly constructed at the project site, in a location acceptable to the Contracting Officer, using materials and methods to be employed in the work; completely finished; maintained during construction; and removed at the conclusion of the work or when authorized by the Contracting Officer.

Sample Installation:

A portion of an assembly or material constructed where directed and, if approved, retained as a part of the work.

SD-18 Records

Documentation required for contract administration.

SD-19 Operation and Maintenance Manuals

The technical specifications identify requirements for operation, maintenance instructions, and parts, and describe specific testing requirements for certain items of equipment and/or systems. Where such requirements exist, the Contractor shall furnish commercially available standard operation and maintenance data, including operating instructions, maintenance instructions and parts listings. Testing procedures shall be furnished as required to demonstrate full compliance with the technical provisions. Detailed requirements for these items follow.

Information required for the preparation of Operation and Maintenance Manuals (O & M) may be furnished in the form of manufacturers' standard brochures, schematics, and other printed instructions. Data shall include as a minimum the following items:

Recommended procedures and frequencies for preventive maintenance, inspection, adjustment, lubrication, and cleaning.

Special tools and equipment required for testing and maintenance.

Parts lists reflecting the true manufacturer's name, part number, and nomenclature.

Recommended spares by part number and nomenclature and spare stocking levels.

Integrated mechanical and electrical system schematics and diagrams to permit operation and troubleshooting after acceptance of the system.

Troubleshooting, checkout, repair, and replacement procurement procedures.

Operating instructions including start-up and shut-down procedures.

Safety considerations including load limits, speed, temperature, and pressure.

Four copies of the above data shall be submitted 30 days prior to onsite delivery, and shall be updated and submitted for final approval not later than 30 days prior to contract completion. Test data shall be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear and legible. Pages for vendor data and/or the manuals shall be bound in three-ring, loose leaf binders and have 3/8-inch holes. Data shall be organized by separate index and tabbed sheets. Caution and warning indications shall be clear and well labeled.

1.3 MARKING

Marking shall be provided for each submittal to identify it by contract number; transmittal date; Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s); submittal name; specification section and paragraph reference; drawing reference; and similar information to distinguish it from other submittals and to identify its contractual requirement source(s).

1.4 SAMPLES

Materials or equipment requiring sample approval shall not be delivered to the site or used in the work until approved in writing by the Contracting Officer.

Samples shall conform to requirements listed below:

Samples shall be marked to show the name of the material, trade name of manufacturer, place of origin, contract number, name and location of the project where the material represented by the sample is to be used, and the name of the contractor submitting the sample.

Samples shall be accompanied by a letter to the Contracting Officer. This letter shall be addressed as stated in the paragraph entitled, "Addressing Correspondence" of Section 01011, General and Administrative Requirements, and shall include descriptive literature, and reference the provisions of the specification or drawings requiring use of the material.

Samples not subjected to destructive tests may be retained until completion of the work, but thereafter will be returned to the Contractor if it so requests in writing, at its own expense. If no request for return of samples is made prior to contract completion, the samples shall become the property of the Government.

Samples shall be physically identical with the proposed material or product to be incorporated in the work, fully fabricated and finished in the specified manner, and full scale. Where variations in color, finish, pattern, or texture are inherent in the material or product represented by the sample, multiple units of the sample, showing the near-limits of the variations and the "average" of the whole range (not less than 3 units), shall be submitted. Each unit shall be marked to describe its relation to the range of the variation. Where samples are specified for selection of color, finish, pattern, or texture, the full set of available choices shall be submitted for the material or product specified. Sizes and quantities of samples shall represent their respective standard unit.

Before submitting samples, the Contractor shall assure that the materials or equipment will be available in quantities required for the project. Any proposed change or substitution shall be resubmitted and approved prior to use in the project.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. The Contractor shall replace such materials or equipment to meet contract requirements.

1.5 SUBMITTAL REQUIREMENTS

The following submittal summary chart itemizes the general and specific submittal requirements under this contract. The following letter codes designate the recipients:

A - Contract Administrator, Mail Stop 126

B - Contracting Officer Technical Representative, (COTR), Mail Stop 465

C - Office of Safety and Facility Assurance, Mail Stop 429

D - Construction Services Unit, Mail Stop 428

E - Accounts Payable and Employee Services Branch, Mail Stop 175

The number following the letter code, as shown in the submittal summary chart, specifies the number of copies to be provided, (e.g., B-6). The required number of all submittals shall be delivered prepaid to Langley Research Center, Hampton, Virginia 23681-0001 addressed to the appropriate recipient and Mail Stop number as shown above.

SUBMITTAL SUMMARY

TITLE	FIRST SUBMITTAL	UPDATE	LTR CODE AND DISTRIBUTION	GOVERNMENT ACTION	SECTION
SD-01, Data					
Mix Designs (Contractor and	** Job)	---	B-6	Approval	03300
Design Calculations	**	---	B-6	Approval	13930
Manufacturer's Catalog Data	30 Days Before Installation	---	B-6	Approval	07220,08100 08331,08333 08520,08710 08805,09514 09920,10275 13852,13930, 15050,15700 15972,16065 16145,16225 16275,16286 16446,16511 16512,16513 16535,16536 16760
SD-04, Drawings					
Connection Diagrams	**	---	B-6	Approval	13930,16275 16286
Control Diagrams	**	---	B-6	Approval	15700
Schematics	**	---	B-6	Approval	15972
Fabrication/ Erection/ Installation Drawings	30 Days Prior to Installation	---	B-6	Approval	07600,08100 08331,08333 08520,10275 13852,15050 15700
As-Built Drawings	Prior to Contract Completion	---	B-1	Approval	01011,15050 16065
SD-06, Instructions					
Manufacturer's Instructions	**	---	B-6	Review	09670,15700
SD-07, Schedules					
Material, Equipment, and Fixture Lists	**	---	B-6	Review	08710,15050 15700

SUBMITTAL SUMMARY

TITLE	FIRST SUBMITTAL	UPDATE	LTR CODE AND DISTRIBUTION	GOVERNMENT ACTION	SECTION
SD-08, Statements					
Material and Equipment Substitutions	Before Field Use	---	B-6	Approval	01011
Application for Making Connection to Utilities	**	---	B-5, C-1	Approval	01011,01060
Utility Outage Requests	7 Days Before Desired Outage	---	D-2	Approval	01011,01060
Plumbing Worker's Qualifications	Prior to Site Work	---	B-1, C-1	Approval	01011
Electrical Worker's Qualifications	Prior to Site Work	---	B-1, C-1	Approval	01011
Mechanical Worker's Qualifications	Prior to Site Work	---	B-1, C-1	Approval	01011
Safety Plan	Prior to Award	---	A-3	Approval	01060
Application for Work on Energized Circuits	Prior to Work Start	---	B-6	Approval	01060
Electrical Safety Worker's Qualifications	Prior to Work Start	---	B-5, C-1	Approval	01060
Demolition Plan	Prior to Work Start	---	B-1, C-1	Review	02220
Welding/Brazing					
Welding/Brazing Procedure Specifications & Procedure Qualification Records (BPS), (WPS), (PQR)	15*	---	B-2	Approval	15055
Welder/Brazer Performance	15 Days Before	---	B-2	Approval	15055

SUBMITTAL SUMMARY

TITLE	FIRST SUBMITTAL	UPDATE	LTR CODE AND DISTRIBUTION	GOVERNMENT ACTION	SECTION
Qualification Records (WPQ), (BPQ)	Welding Work				
SD-09, Reports					
Test Reports	10 Days After Test Completion	---	B-6	Review	13930,16286 16446
Field Test Report	5 Days After Test	---	B-6	Review	13930,15050 15700,16065 16145,16275
SD-13, Certificates					
Certificates of Compliance	30 Days Before Installation	---	B-6	Review	03300,16225 16275,16286 16446,16511
SD-14, Samples					
Color Selection Sample	30 Days Before Use	---	B-2	Approval	09670,09920 10275,16446
SD-18, Records					
GFP Property Non Conformance Report	As Req'd	---	B-5, A-1	Review	01010,01011
Invoices	Monthly	---	E-2	Approval	01011
Contractor Release Form	At Contract Completion	---	E-1	Review	01011
Price Breakdown for Modification Proposals	14 Days After Change or Proposal Request	---	A-2	Approval	01011
Price Breakdown for Progress Payments	10*	---	A-6	Approval	01011
Order Status Reports	**	---	B-3	Information	01011

SUBMITTAL SUMMARY

TITLE	FIRST SUBMITTAL	UPDATE	LTR CODE AND DISTRIBUTION	GOVERNMENT ACTION	SECTION
Schedule of Construction	30*	---	A-1, B-5	Approval	01011
Monthly Progress Schedules	30*	15th Day of Each Month	A-1, B-5	Review	01011
Monthly Technical Progress Narratives	30*	15th Day of Each Month	A-1, B-5	Review	01011
Certified Payrolls	Weekly	---	D-2	Review	01011
Record of Existing Conditions	Prior to Work Start	---	B-1, D-1	Review	02220,15050
SD-19, Operation and Maintenance Manuals	30 Days Prior to Onsite Const.	30 Days Prior to Contract Completion	B-4	Review	01011,08331 15050,15700 15972

* Days given after date of receipt of Notice to Proceed

** As required by specifying section with updates when significant changes occur

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

Technical Submittal Form

TO:	Date Received:
FROM:	Distribution:
Contract No.: / Title:	

TO BE COMPLETED BY CONTRACTOR

Submittal	Submittal Number:	Previous Submittal Number:
☐ New ☐ Previous		

Item #	Specification Section Para No./Dwg. No.	SD No.	Description of Material (Include Type, Model No., Catalog No., Mfg., Etc.)	Action Code	Initials

Contractor Representative:	Signature:	Date:

Government Action Codes: A-Approved; AC-Approved with corrections as noted; R-Returned for corrections; RE-Reviewed; RC-Reviewed with comment

FOR GOVERNMENT USE ONLY

To Reviewer:	M/S:	To Reviewer: Date:	From Reviewer: Date:

Comments

Reviewer:	Signature:	Date:
Approval *(Name and Title)*:	Signature:	Date:

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

-- End of Section Table of Contents --

SECTION 01420

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Reference publications are cited in other sections of the specifications along with identification of their sponsoring organizations. The addresses of the sponsoring organizations are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

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Northbrook, IL 60062-2096
Ph: 800-704-4050
Fax: 847-509-6249
Internet: http://www.ul.com/
Order from:
Global Engineering Documents
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Englewood, CO 80112-5776
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E-mail: global@ihs.com

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

2655 Villa Creek Dr., Suite 155
Dallas, TX 75234
Ph: 214-243-3902
Fax: 214-243-3907

U. S. ARMY ENVIORNMENTAL HYGIENE AGENCY (USAEHA)

Waste Disposal Engineering Division
Aberdeen Proving Ground, MD 21010-5422
Ph: 410-671-3652

VIRGINIA CODE COMMISSION (VR)

910 Capitol St. F1 2
Richmond, VA
Ph: 804-786-3591

WATER ENVIRONMENT FEDERATION (WEF)

601 Wythe St.
Alexandria, VA 22314-1994
Ph: 703-684-2400
Fax: 703-684-2492
Internet: www.wef.org

WATER QUALITY ASSOCIATION (WQA)

4151 Naperville Rd.
Lisle, IL 60532
Ph: 630-505-0160
Fax: 630-505-9637
WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

P.O. Box 23145
Portland, OR 97281

Ph: 503-639-0651
Fax: 503-684-8928

WESTERN WOOD PRESERVERS INSTITUTE (WWPI)

7017 N.E. Highway 99 # 108
Vancover, WA 98666
Ph: 360-693-9958
Fax: 360-693-9967

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

Yeon Bldg.
522 SW 5th Ave.
Portland, OR 97204-2122
Ph: 503-224-3930
Fax: 503-224-3934

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)

507 First Street
Woodland, CA 95695
Ph: 916-661-9591
Fax: 916-661-9586

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-- End of Section Table of Contents --

SECTION 02220

DEMOLITION

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-08 Statements

Contractor shall prepare and submit a detailed Demolition Plan of the work procedures and safety precautions to be used in the identification, demolition, handling, removal, transportation, and reclamation or disposal of removed materials. Contractor shall meet with the Contracting Officer, prior to beginning work, to discuss in detail the demolition plan.

SD-18 Records

Existing Conditions shall be recorded in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Such record shall contain the elevation of the top of foundation walls, the location and extent of cracks and other damage and description of surface conditions that exist prior to the start of work. Copies of the record shall be submitted and the stated conditions before starting work shall be verified.

PART 2 PRODUCTS

2.1 FILL MATERIAL

Fill material shall conform to the definition of satisfactory soil material as defined in AASHTO M 145, Soil Classification Groups A-1, A-2-4, A-2-5 and A-3. In addition, fill material shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.

PART 3 EXECUTION

3.1 DISCONNECTING EXISTING UTILITIES

Prior to the start of work, utilities serving each area of alteration or removal will be shut off by the Government and shall be disconnected and sealed by the Contractor.

3.2 PRECAUTION AGAINST MOVEMENT

Contractor shall provide shoring and bracing or other supports to prevent movement, settlement, or collapse of facilities that are to remain which are adjacent to areas of alteration and removal.

3.3 DEMOLITION AND REMOVAL WORK

3.3.1 Demolition

3.3.1.1 Concurrent Earth-Moving Operations

Excavation, filling, and other earth-moving operations that are sequential to demolition work shall not be started in areas occupied by structures to be demolished until all demolition in the area has been completed and debris has been removed.

3.3.1.2 On-Grade and Below-Grade Construction

Foundations, on ground footings, and other similar construction shall be demolished and removed.

3.3.1.3 Filling Voids

Voids resulting from the demolition of structures shall be completely filled with specified fill material and graded.

Prior to filling, voids shall be free of standing water, frost, frozen material, trash, and debris.

After fill has been placed, the surface of the fill shall be graded to meet adjacent contours and to provide surface water drainage.

3.3.2 Protective Measures

Existing construction shall not be disturbed beyond the extent indicated or necessary for installation of new work. Temporary shoring and bracing shall be provided for support of building components to prevent settlement or other movement.

Protective measures shall be provided to control accumulation and migration of dust and dirt in all areas of work. Dust, dirt, and debris shall be removed from the areas of work daily.

3.3.3 Salvageable Materials and Equipment

Government will designate materials and equipment to be salvaged.

Salvageable materials and equipment shall be removed in a manner that will cause the least possible damage thereto. Contractor personnel shall handle, store, and protect removed items that are to be reused in the work or are to be retained by the Government.

Identification tags shall be provided on items boxed or placed in containers, indicating the type, size, and quantity of materials.

3.3.4 Scrap Metal

Scrap metal shall be stockpiled in designated areas, according to type of metal. The Government will provide containers on site for scrap metal collection.

3.3.5 Buildings and Structures

Specified removal operations shall be performed in existing buildings as required to complete the work.

Concrete:

Existing concrete shall be demolished, removed, and disposed of. Square, straight edges shall be provided where existing concrete adjoins new work and other locations. Existing steel reinforcement shall be protected where indicated or shall be cut off flush with face of concrete.

Masonry:

All masonry construction shall be demolished and removed.

Structural steel:

Structural steel components shall be dismantled and disposed of in Government provided containers.

Miscellaneous metals:

Shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, and similar items shall be classified as scrap and disposed of in Government containers.

3.3.6 Mechanical Equipment and Fixtures

Mechanical hardware shall be disconnected at the nearest convenient connection to existing services that are to remain, or as indicated.

Disconnection from utilities:

Mechanical equipment and fixtures shall be disconnected at fittings. Service valves shall be removed and attached to the unit.

Piping:

Piping and fittings not designated for salvage, or reuse, shall be considered as scrap metal.

Ducts:

Removed duct work shall be classified as scrap metal.

Fixtures:

Fixtures associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations shall be classified as scrap metal.

3.4 DISPOSAL OF REMOVED MATERIALS

3.4.1 General

Debris, rubbish, and other nonsalvageable materials resulting from removal operations shall be disposed of in accordance with all applicable federal, state and local regulations as contractually specified off the center. Removed materials shall not be stored on the project site. Scrap metal and scrap wire shall be placed in the Government furnished containers which will be appropriately labeled.

3.4.2 Burning on Government Property

Burning of materials removed from demolished structures will not be permitted on Government property.

3.4.3 Removal from Government Property

Waste materials removed from demolished structures shall be transported from Government property and legally disposed of.

3.5 REUSE OF SALVAGED ITEMS

Salvaged materials and equipment designated for reuse shall be reconditioned before installation. Items damaged during removal and salvage operations shall be repaired or replaced as necessary to restore them to usable condition, at no additional cost to the Government.

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 308	(1992) Standard Practice for Curing Concrete
ACI 318	(1999) Building Code Requirements for Reinforced Concrete
ACI 347	(1994) Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(2000) Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 143	(2000) Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C 309	(1998) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1999) Chemical Admixtures for Concrete
ASTM C 618	(2000) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 94	(2000) Standard Specification for Ready-Mixed Concrete

1.2 GENERAL

All work shall be in accordance with ACI 318.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the

specification:

SD-01 Data

Mix Designs Data shall be submitted in accordance with the paragraph entitled, "Ready-Mix Concrete," of this section.

SD-13 Certificates

Bill of Lading for each Ready-Mix Concrete delivery shall be in accordance with ASTM C 94.

PART 2 PRODUCTS

2.1 READY-MIX CONCRETE

Concrete shall be ready-mix concrete and shall conform to ASTM C 94, minimum compressive strength 3000 psi at 28 days. Slump shall be between 2 and 4 inches, according to ASTM C 143.

Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C 494.

Fly ash or other pozzolans used as admixtures shall conform to ASTM C 618, Class C with 4 percent maximum loss on ignition and 20 percent maximum cement replacement by weight.

2.2 STEEL REINFORCEMENT

2.2.1 Deformed Steel Bars

Steel bars shall conform to ASTM A 615/A 615M, Grade 60 and ACI 318.

2.2.2 Welded Wire Fabric

Welded wire fabric shall conform to ASTM A 185.

2.3 FORMS

Forms shall be of wood, steel, or other approved material and shall conform to ACI 318.

Form release shall conform to ACI 347.

2.4 CURING COMPOUND

Curing compound shall conform to ASTM C 309.

PART 3 EXECUTION

3.1 CONCRETE CONVEYING

Concrete shall be conveyed from mixers to forms as rapidly as practical by methods that will prevent segregation or loss of ingredients.

3.2 CONCRETE PLACING

3.2.1 General Placing Requirements

Concrete shall be placed in accordance with ACI 318.

Concrete shall be worked into the corners and angles of the forms and around reinforcement and embedded items without permitting the materials to segregate. Concrete shall be placed within 90 minutes after it has been mixed. It shall be placed on clean, damp surfaces free from water, ice, frost, mud, debris, or objectionable coatings. Concrete shall be consolidated with the aid of mechanical vibrating equipment supplemented by handspading and tamping. Vibrating equipment shall be of the internal type.

3.3 TROWEL FINISH

A trowel finish shall be applied to slab surfaces that are to be exposed to view or covered with resilient flooring, paint, or other finish coating systems.

Final troweling shall be started when a ringing sound is produced as trowel is moved over the surface. Surface shall be consolidated by hand troweling operation. Finished surfaces shall be free of trowel marks, uniform in texture and appearance, and plane to a tolerance not exceeding 1/4 inch in 10 feet when tested with a 10-foot straightedge placed on the surface in any direction. Surface defects of sufficient magnitude to show through floor covering shall be removed by grinding.

3.4 CURING AND PROTECTION

Concrete shall be cured in accordance with ACI 308.

Curing shall be accomplished by moist curing, by moisture-retaining cover curing, by membrane curing, or by combinations thereof.

Moist curing shall be accomplished by keeping surface of concrete wet or by covering with absorptive cover saturated with water and kept wet.

Moisture-retaining cover curing shall be accomplished by covering concrete surfaces with moisture-retaining cover for curing concrete.

Membrane curing shall be accomplished by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared.

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SECTION 04220

CONCRETE MASONRY UNITS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615/A 615M	(2000) Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 82	(1997) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C 144	(1997) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2000) Standard Specification for Portland Cement
ASTM C 207	(1991; R 1997) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 270	(2000) Standard Specification for Mortar for Unit Masonry
ASTM C 404	(1997) Standard Specification for Aggregates for Masonry Grouts
ASTM C 476	(1999) Standard Specification for Grout Masonry
ASTM C 90	(2000) Standard Specification for Load-Bearing Concrete Masonry Units

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

Concrete masonry units shall include all special shapes and sizes required to complete the work. Concrete masonry units shall conform to ASTM C 90, Type I or II, Grade N, light weight.

2.2 MORTAR

Mortar shall be mixed in proportions as specified in ASTM C 270.

2.3 GROUT

Grout shall conform to ASTM C 476. Compressive strength at 28 days shall

be 2,000 pounds per square inch (psi) minimum.

2.4 PORTLAND CEMENT

Portland cement shall conform to ASTM C 150, Type II.

2.5 AGGREGATE

Sand for mortar shall conform to ASTM C 144. Pea gravel for grout shall conform to ASTM C 404.

2.6 LIME

Hydrated lime shall conform to ASTM C 207, Type S.

2.7 WATER

Water shall be potable.

2.8 REINFORCEMENT

2.8.1 Joint Reinforcement

Joint reinforcement shall be fabricated from steel wire conforming to ASTM A 82. Longitudinal wires shall be not lighter than 0.1483-inch nominal diameter. Cross wires shall be not lighter than 0.1055-inch nominal diameter. Joint reinforcement shall be furnished in flat sections.

2.8.2 Reinforcing Steel Bars

Reinforcing steel bars shall conform to ASTM A 615/A 615M, Grade 60, deformed, free of loose rust and scale.

2.9 PRECAST LINTELS

Precast lintel units shall be cast with cement and aggregates similar to that used for masonry units and shall have a 28-day compressive strength of 3,000 psi or more. Lintels shall be of length sufficient to bear 8 inches minimum of each side of the opening.

PART 3 EXECUTION

3.1 MORTAR

Mortar shall be thoroughly machine mixed for a period of 3 to 5 minutes after all materials are in a mixer designed for this purpose.

Mortar shall be used and placed in final position within 1-1/2 hours after mixing when air temperature is less than 80 degrees F. No mortar shall be placed when air temperature is 40 degrees F and falling.

Mortars that have stiffened within the allowable time may be retempered to restore workability by adding water as frequently as needed.

3.2 LAYING CONCRETE BLOCK

Block shall be laid dry and cut accurately to fit other construction. All cutting of units shall be done with power saws with abrasive blades.

Block work shall be laid plumb, level, and true to line and grade.

Running bond pattern shall be used.

Mortar joints shall be 3/8-inch thick. Full mortar coverage of bed joints shall be provided at shells.

Precast lintels shall be used over openings.

3.3 REINFORCEMENT

Reinforcement shall be placed straight, centered in cells, and tied at laps and intersection of bars. Vertical steel shall be braced at 192 bar diameters maximum spacing and at top and bottom to ensure alignment.

Dowels shall be provided of the same size for each vertical and horizontal bar required on the anchorage.

Steel shall be encased in grout with at least 1/2 inch between any bar and masonry.

At least one No. 4 bar shall be provided at each vertical side of openings exceeding 24 inches.

3.4 JOINT REINFORCEMENT

Control joints shall be constructed with continuous interrupted lengths of joint reinforcing through expansion relief cuts. Reinforcement shall be placed to ensure a minimum of 5/8-inch mortar cover on the exterior face of the wall and 1/2-inch mortar cover on interior faces.

3.5 JOINTING AND POINTING EXPOSED MASONRY

Joints shall be pointed and tooled before mortar is set and brushed with a fiber brush after tooling. Exterior joints shall be concave; interior joints shall have flush packed joints.

3.6 EMBEDDED ITEMS

Embedded items shall be set in accordance with the construction drawings. Anchors shall be surrounded by grout.

3.7 METAL DOOR JAMBS

Metal door jambs in masonry walls shall have frames filled solidly with mortar as the work progresses.

3.8 CLEANING

Grout or mortar stains shall be cleaned by removing immediately with clear water, stiff fiber brushes, or wooden scrapers, and rinsed before final acceptance.

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SECTION 06100

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SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1	(1965; R 1998) Plain Washers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(1996) Square and Hex Bolts and Screws, Including Hex Cap and Lag Screws (Inch Series)
ASME B18.6.1	(1981; R 1991) Wood Screws (Inch Series)

AMERICAN WOOD PRESERVERS BUREAU (AWPB)

AWPB LP 2	(1988) Softwood Lumber, Timber and Plywood Pressure Treated with Water-Borne Preservatives for Aboveground Use

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA P5	(2000) Standards for Waterborne Preservatives
AWPA P8	(2000) Oil-Borne Preservatives

FEDERAL SPECIFICATIONS (FS)

FS FF-B-588	(Rev E) Bolt, Toggle; and Expansion Sleeve, Screw
FS FF-N-105	(Rev B; Int Am 4) Nails, Brads, Staples, and Spikes: Wire, Cut, and Wrought
FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS TT-W-571	(Rev J) Wood Preservation: Treating Practices

NATIONAL INSTITUTE FOR STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(1983) Construction and Industrial Plywood
NIST PS 20	(1970; Rev 1986) American Softwood Lumber Standards

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1001	(1994) Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA-01	(1995) Western Lumber Grading Rules 91

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 General Requirements

Each piece of framing lumber, board lumber, and plywood shall bear the trademark and grade identification of the manufacturer's association or the authorized inspection bureau under rules of which the lumber is manufactured and graded.

Softwood lumber shall be seasoned S4S and kiln-dried or air-dried to the specified moisture content. Dressed sizes shall conform to NIST PS 20.

Moisture content shall conform to the rules of the lumber association or the inspection bureau under which the lumber is graded but shall not exceed 15 percent for boards and dimensional lumber 2 inches or less in thickness.

2.1.2 Light-Framing Materials

Light-framing materials and studs over 10 feet in length shall be of the following species:

Southern yellow pine	No. 2 KD dimensions, SPIB 1001

2.1.3 Board Materials

Board materials shall be one of the following species:

Southern yellow pine	No. 2 boards SPIB 1001
White fir, ponderosa pine, western cedar, incense cedar, Idaho white pine, sugar pine	Utility Grade, WWPA-01 Grading Rules

2.1.4 Plywood Sheathing

Plywood sheathing shall be unsanded exterior-grade sheathing, grade stamped "Ext-DFPA," and manufactured in accordance with NIST PS 1, Group 1.

2.1.5 Preservative Treated Lumber

The following wood members shall be pressure-preservative treated in accordance with FS TT-W-571 or AWPB LP 2. Each piece shall bear the AWPB stamp, indicating point of treatment, preservative symbol, symbol of standard, date of treatment, and moisture content after treatment:

Wood sills, plates, rough bucks, and frames in exterior masonry wall openings

Wall plates and furring in contact with exterior masonry or concrete

Nailers that are set into, or are in contact with, concrete or masonry

Blocking and nailers for roof deck, sub fascia members, roof cants and saddles

Preservative shall be either water-borne, conforming to AWPA P5, or oil-borne conforming, to AWPA P8.

Nailers to receive membrane waterproofing and wood members to receive finish materials shall be treated with a water-borne preservative to eliminate preservative bleed-through at nails.

Wood treated with oil-borne preservatives shall be clean, free from surface oil, and properly seasoned for use.

Wood treated with water-borne preservatives shall be air-dried or kiln-dried to reduce maximum moisture content to 15 percent.

Treated wood exposed in the final structure shall be free from objectionable odors and shall not be harmful or corrosive to adjacent materials or anchorages.

2.2 ANCHORAGE AND FASTENER MATERIALS

2.2.1 Nails and Staples

Nails, staples, and tacks shall conform to FS FF-N-105.

Nails for fastening interior wood partitions or rough framing shall be steel wire nails.

Nails for roof blocking, cants, and nailers shall be galvanized.

Nails used to fasten exposed wood fascias or finished wood members exposed to the weather shall be aluminum alloy or galvanized finishing nails.

Power-driven staples shall be galvanized Type III, Style 3.

2.2.2 Bolts, Nuts and Screws

Bolts and nuts shall be carbon steel, galvanized, conforming to ASTM A 307, Grade A.

Wood screws shall be carbon steel, galvanized, conforming to ASME B18.6.1.

Lag screws or lag bolts shall be commercial steel, galvanized, conforming to

ASME B18.2.1.

Expansion shields, expansion nails, and drive screw devices shall conform to FS FF-S-325.

Toggle bolts shall conform to FS FF-B-588.

Washers shall be carbon steel, galvanized, general assembly purpose type, conforming to ANSI B18.22.1.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Members shall be framed for the passage of ducts and pipes and shall not be cut, notched, or bored more than one quarter of their depth without approved reinforcement.

Washers shall be provided under bolt heads or nuts in contact with wood. Lumber shall be bored to receive bolts.

Nailers, blocking, and furring shall be furnished in lengths that minimize joints.

3.1.2 Blocking, Cant Strips, and Nailers

Nailing strips, blocking, cant strips, and sub fascia wood members shall be continuous, cut with square ends and in maximum practical lengths.

For bolted connections, sub fascia members shall be fastened to structural steel members or concrete with 1/2-inch bolts at a maximum spacing of 4 feet on center, one bolt near each end of the member. Bolt heads shall be countersunk flush with the surface of the wood. Sub fascia members shall be held to a tolerance of 1/8 inch in 10 feet.

Wood cant strips shall be not less than 4-inches long and set at projections through the roof deck, expansion joints, and fascias.

Perimeter roof blocking, nailers, and cants shall be groove-cut to provide ventilation for insulation. Groove cuts shall be matched for continuity or new vent grooves cut when wide vents are built of more than one width of wood.

Bottom half of nailers shall be cut to provide a net open area equivalent to 10 percent of the edge face.

Wood vents for parapet walls and other vertical surfaces shall be 1-inch nominal thickness, treated boards, installed continuously. Wall side of vent shall be cut to provide a net open area equivalent to 20 percent of the thickness edge.

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SECTION 07220

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SECTION 07220

ROOF AND DECK INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1289	(1998) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 728	(1997) Standard Specification for Perlite Thermal Insulation Board
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Thermal Insulation Materials
Fastening Materials

1.3 QUALIFICATIONS FOR ROOF AND DECK INSULATION WORK

Work shall be performed by contractor personnel certified by the manufacturer for roof insulation (rigid board or poured) applications and installations.

Insulating concrete contractor shall be certified by the aggregate manufacturer to be approved for application of the materials.

1.4 DELIVERY AND STORAGE OF MATERIALS

Materials shall be delivered to the project site in their original, unopened packages or containers bearing labels identifying the manufacturer's name, brand name, material, and other information.

Materials shall be stored in their original, unbroken packages or containers in a weathertight and dry area and protected from damage until needed for use.

1.5 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F or when there is ice, frost, or moisture visible on the roof deck.

PART 2 PRODUCTS

2.1 THERMAL INSULATION MATERIALS

2.1.1 Insulation Types

Roof insulation shall be an assembly of the following materials and compatible with attachment methods for the specified insulation and roof membrane:

Expanded Perlite Board: ASTM C 728. Minimum 1 inch thick when both top and bottom surfaces will be in contact with asphalt.

Polyisocyanurate Board: ASTM C 1289, thickness as indicated, Type II, fibrous felt or glass mat membrane both sides.

Tapered Perlite Insulation Board: ASTM C 728.

2.2 BITUMENS

2.2.1 Asphalt Primer

ASTM D 41.

2.2.2 Asphalt

ASTM D312, Type III or IV.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Roof insulation shall be installed in accordance with approved descriptive data and as specified in this scection and in Section 07510, "Built-Up Bituminous Roofing."

Contractor shall examine deck surfaces for inadequate anchorage, foreign material, moisture, and unevenness. Any condition which would prevent the execution and quality of application of roof insulation system as specified shall brought to the attention of the Contracting Officer for determination of required repair work. Work shall not proceed with insulation application until defects are corrected.

Starting work designates acceptance of the surfaces by the Contractor.

Insulation material shall be cut and fit as necessary to fully insulate small areas and to accommodate piping, scuttles, skylights, vents, and other construction penetrating the insulation material.

3.2 PREPARATION

3.2.1 Protection of Property

Flame-heated equipment shall be located and used so it will not endanger the structure or other materials on the site or adjacent property. Fire extinguishers shall be in accordance with Section 01060 and maintained by the Contractor.

Flame-heated equipment shall not be placed on the roof of any structure.

Before starting work, paving and faces of building walls adjacent to hoist and kettles shall be protected and this protection maintained for duration of work.

3.2.2 Preparation of Surfaces

Surfaces on which thermal insulation materials are to be applied shall be clean, smooth, dry, and free from projections which might puncture the vapor barriers. Condition of surfaces shall be inspected and approved by the Contracting Officer prior to the start of roof insulation work. Prior to installing insulation, perform the following:
In the presence of the Contracting Officer perform the following surface-dryness test on concrete substrates:

(1) Foaming: When poured on the deck, one pint of asphalt when heated in the range of 350 to 400 degrees F, shall not foam upon contact.

(2) Strippability: After asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from surface, do not consider surface to be dry and do not start application. Should rain occur during application, stop work and do not resume until surface has been tested by method above and found dry.

3.3 APPLICATION

3.3.1 General Procedures

Insulation installation shall be continuous, with all operations proceeding together.

Before cessation of work on each working day or when work is interrupted due to rainfall or other causes, the roof shall be sealed against intrusion of water. Insulation shall not be left exposed during rainfall or overnight.

Traffic over partially or completely finished insulation shall be only on planks, or on plywood not less than 5/8-inch thick and 2-feet wide.

Materials temporarily stored on the roof shall be distributed to stay within the live-load limits of the roof, which is 20 psf. Ample bases shall be provided under equipment to distribute the weight to conform to the live-load limits.

3.3.2 Heating Bitumens

Asphalt shall be heated and applied at its respective Equiviscous Temperature (EVT) plus or minus 25 degrees F.

Contractor shall provide thermostatic controls and visible thermometer on

the kettle and shall maintain them in working order and keep them calibrated.

Foreman shall carry immersion thermometers accurate within plus or minus 2 degrees F and shall frequently check temperatures. If the temperature of the bitumens in the applicators is below specified amounts, removal and replacement of the effected roofing may be required.

3.3.3 Insulation Application

Insulation shall be installed in accordance with the manufacturer's requirements and as specified below. Method of holddown used by the manufacturer in areas subject to hurricane velocity winds shall be subject to approval by the Contracting Officer prior to installation.

Total nominal thickness shall be installed in minimum two layers. The top layer of insulation shall consist of the specified layer of perlite insulation. No more insulation shall be installed at one time than can be protected from wetting or other damage by installation of roofing membranes on the same day or prior to rain or dew.

Layer to receive the roofing membrane shall be installed with longitudinal joints parallel to the short dimension of the roof. Joints shall be staggered in each layer. First layer and between layers shall be solid-mopped. Membrane shall be laid with edges in moderate contact, but not forced into place. End joints shall be staggered.

Joints of insulation board shall be taped, if required by the manufacturers of insulation and roofing.

Temporary water cutoffs shall be installed at the completion of each day's work and removed upon resumption of work.

3.3.4 Installation Using Asphalt

Firmly embed each layer in solid asphalt mopping; mop only sufficient area to provide complete embedment of one board at a time. Provide 20 to 35 lbs of asphalt per 100 square feet of roof deck for each layer of insulation. Apply asphalt when temperature is within plus or minus 25 degrees F of EVT. Do not heat asphalt above asphalt's FBT or 525 degrees F, whichever is less, for longer than 4 consecutive hours. Use thermometers to check temperatures during heating and application.

3.4 PROTECTION

Completely cover each day's installation of insulation with the finished roofing specified in Section 07510, "Built-Up Bituminous Roofing." on same day. Do not permit phased construction. Protect open ends of each day's work with temporary water cutoffs, and remove when work is resumed. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank waLkways, runways, and platforms near supports, as necessary, to distribute weight to conform to a 20 psf live load limit.

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SECTION 07510

BUILT-UP BITUMINOUS ROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208	(1995) Standard Specification for Insulation Boards (Cellulosic Fiber) Structural and Decorative
ASTM D 1227	(1995) Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D 2178	(1997) Asphalt Glass (Felt) Used in Roofing and Waterproofing
ASTM D 312	(2000) Standard Specification for Asphalt Used in Roofing
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4586	(1993; R 1999) Standard Specification for Asphalt Roof Cement, Asbestos Free

1.2 SYSTEM DESCRIPTION

1.2.1 Roofing System

Contractor shall provide a roofing system with asphalt bitumen and aggregate surfacing on a metal deck with insulation.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Asphalt Primer
Asphalt
Roofing Felts
Cant Strip
Cap Sheets
Bituminous Plastic Cement

Surfacing Aggregate

Manufacturer's performance data indicating installation method for providing Factory Mutual Class I-90 (90 psf) wind uplift resistance.

Data shall include written acceptance by the roof membrane manufacturer of the insulation to be provided.

1.4 DELIVERY, HANDLING, AND STORAGE

Roofing materials shall be on the project site before work is begun.

Materials shall be delivered to the site in the manufacturer's unbroken labeled packages. Felt rolls shall be labeled to indicate grade, weight, and type of saturant. Original packaging shall not be disturbed until materials are to be applied. Liquid materials shall be used directly from the fully labeled cans in which they were shipped by the manufacturer. Only approved by the Contracting Officer roofing materials may be brought to or stored at the site.

Roofing materials shall be stored and protected from contact with soil, rain, or snow. Felt rolls and roll roofing shall be stacked on end and stored in an area maintained at no lower temperature than 50 degrees F for at least 24 hours before laying.

Not more than a 1-day supply of insulation or felts shall be stored on the roof at any time. This 1-day supply shall be stacked on pallets and completely covered with plastic sheet whenever work is interrupted or when there is precipitation of any kind. Plastic sheeting shall be securely fastened to the pallets so as to be completely weathertight. Materials not so protected shall be permanently removed from the site.

Materials temporarily stored on the roof shall be distributed to stay within the indicated live-load limits of the roof construction. Ample bases shall be provided under equipment to distribute the weight to conform to these live-load limits. Storage locations shall be approved by the Contracting Officer.

PART 2 PRODUCTS

2.1 GENERAL

No products provided by these specifications shall contain asbestos.

2.2 ASPHALT-PRIMER

Asphalt primer shall conform to ASTM D 41.

2.3 ASPHALT

Asphalt shall conform to ASTM D 312, Type II.

2.4 ROOFING FELTS

Roofing felt shall be asphalt-impregnated glass fiber conforming to ASTM D 2178, Type VI.

2.5 MINERAL SURFACED CAP SHEETS

Provide flashing felt specifically prepared in the manufacturing process for use in two-ply base flashing construction of either: a single thickness of glass felt conforming to the properties listed in ASTM D 2178, for Type IV; or glass felt factory-laminated to a woven glass fiber scrim or cotton fabric; or styrene-butadiene-styrene (SBS) or atactic polypropylene (APP) modified bitumen. Factory-coat each type of flashing construction on one side with an asphaltic coating which includes a water-insoluble, fine mineral stabilizer and a fine mineral surfacing and white ceramic granules on the exposed side. Provide minimum 2-inch uncoated selvage edge.

2.6 BITUMINOUS PLASTIC CEMENT

Plastic cement shall conform to ASTM D 4586, Type I for horizontal applications and Type II for vertical applications.

2.7 FASTENERS

Roofing nails shall be galvanized with diameter heads (annular or spiral-threaded for plywood deck) of sufficient length for maximum penetration into the deck or wood nailer.

Self-clinching nails shall have a minimum holding capacity of 20 pounds per fastener when driven.

2.8 CANTS

Cants shall be made from treated fiberboard, or from treated wood as indicated, and shall reduce the angle covered into two equal angles. Fiberboard shall conform to ASTM C 208, treated for moisture resistance by an integral treatment with wax or with bituminous impregnation.

2.9 AGGREGATE SURFACING

Aggregate shall be white crystalline marble, of at least 55 pounds per cubic foot density and shall be light colored, opaque, with the surface dry and free from dirt or other foreign material. Testing the surfacing material shall be the responsibility of the Contractor.

Grading of aggregate at the time of application shall conform to the following:

Percentage passing a 5/8-inch sieve and retained on a 1/4-inch sieve; not less than 100

2.10 ASPHALT-BASE EMULSION

Asphalt-base emulsion shall conform to ASTM D 1227, Type IV.

PART 3 EXECUTION

3.1 EXAMINATION

Contractor shall examine deck surfaces for inadequate anchorage, foreign material, moisture, and unevenness that would prevent the execution and quality of application of built-up roofing system as specified.

Contractor shall not proceed with the roofing application until defects have been corrected.

Starting work designates acceptance of the surfaces by the Contractor.

3.2 PREPARATION

Flame-heated equipment shall be located and used so it will not endanger the structure, other materials on the site, or adjacent property. Fire extinguishers shall be in accordance with Section 01060 and maintained by the Contractor.

Flame-heated equipment shall not be placed on the roof of any structure.

Before the start of work, paving, yards, and the face of building walls adjacent to the hoist and kettles shall be protected and this protection shall be maintained for duration of work.

3.3 APPLICATION

3.3.1 General Procedures

Roofing installation shall be continuous, with all operations proceeding together. Base sheet and specified plies of felt shall follow shingle-fashion as a single composite operation.

Roofing shall not be applied when ambient temperature is below 50 degrees F.

Interval between the base sheet application and succeeding plies shall not exceed 48 hours.

Before cessation of work on each working day or when work is interrupted due to rainfall or other causes, the roof shall be sealed against intrusion of water. Base sheet shall be brought to the edge of the insulation, dams shall be installed, and exposed felts shall be effectively glazed. Insulation or unglazed felts shall not be left exposed during rainfall or overnight.

Traffic over partially or completely finished roofing shall be only on planks or on plywood not less than 5/8-inch thick and 2-feet wide.

Debris shall be removed from the roof at the end of each work day.

3.3.2 Heating Bitumens

Maximum bitumen temperature in kettle:

Asphalt, Type II: 475 degrees F

Bitumen heated above the specified maximum shall be discarded.

Minimum bitumen temperature at the time and point of application:

Asphalt, Type II: 400 degrees F

Contractor shall provide thermostatic controls and a visible thermometer on the kettle, shall maintain them in working order, and shall keep them calibrated.

Contractor shall use thermometers accurate within plus or minus 2 degrees F and check temperatures every 30 minutes. When the temperature of the

bitumens in the applicators falls below specified minimums, removal and replacement of the affected roofing may be required.

3.3.3 Built-Up Roofing Application

Roofing shall be installed in accordance with the roofing manufacturer's specification for the roofing system required for the project and as specified below. Method of holddown used by the manufacturer in areas subject to hurricane winds shall be subject to approval prior to installation.

Heated bitumen shall be solid mopped under and between roofing felts with a complete uniform coating. Felt shall not touch felt. Roofing felts shall be laid parallel to the long dimension of the roof. Felts shall be broomed or pressed into the heated bitumen, providing tight smooth laminations without wrinkles, buckles, kinks, or fishmouths. Application of the roofing system shall be completed without pockets or blisters.

Kettlemen shall be in attendance at all times during the heating to ensure that the maximum temperature specified is not exceeded. Layers of roofing shall be laid in not less than 25 pounds of asphalt per square. Bitumen shall uniformly cover roof areas to be mopped to provide an effective bond. Asphalt primer for concrete and masonry surfaces to receive asphalt products shall be applied at a rate of not less than 1 gallon per square. Each course of roofing felts and base sheet, in addition to being mopped in hot bitumen, shall be lapped as specified by the manufacturer. Roofing, including the base sheet and roofing felts, shall immediately follow the insulation application as a continuous operation. Where roofing is applied either to the deck or over insulation and requires several working days for completion, the base sheet application may be completed over the surface area under the following three conditions:

Base-sheet laps shall be waterproofed with a solid application of hot bitumen.

Remaining plies of roofing shall be installed so that the base sheet is not left exposed to the weather longer than 1 week.

This method of application shall be proposed in writing in advance of the actual work and shall include a detailed schedule of the roofing contractor's operations. This method of application shall not be used in lieu of the continuous operation without prior approval.

Surface of the felts shall be carefully broomed-in with a 18- or 20-inch wide, soft-fiber floor broom to obtain complete adhesion between plies and to eliminate air pockets. Method of mopping a half-sheet width and turning the sheet back to mop under the other half shall not be used. Workers shall not walk on mopped surfaces when the bitumen is sticky. Each layer of roofing felt shall be carried up abutting vertical surfaces at least 4 inches or to the top of the cant strip.

Nails and fasteners for securing roofing shall be the following types and shall be flush-driven through flat metal disks not less than 1 inch in diameter. Metal disks may be omitted where heads of fasteners are equivalent in size to the 1-inch diameter disks.

Application into a wood roof nailer set flush with the surface of nonnailable insulation shall be with roofing nails.

3.3.4 Flashing Applications

Flashings shall be provided in the angles formed at walls and other vertical surfaces and where required to make the work watertight. Bituminous-plastic flashings specified shall be used, except where metal flashings are indicated or specified in Section 07600, "Flashing and Sheetmetal." Flashings shall be provided and installed immediately after the top ply of the roofing is placed and shall be returned and sealed or capped and sealed to waterproof edges and ends. Flashings shall be stepped where vertical surfaces abut sloped roof surfaces.

Base flashings shall consist of four layers of asphalt-saturated felt and one layer of mineral-surfaced cap sheet cemented together with bituminous cement. Masonry and concrete over which flashing is to be installed shall be primed with asphalt primer and allowed to dry. Layers of saturated felt and the mineral-surfaced cap sheet shall be evenly embedded in bituminous cement applied with a trowel, using not less than 50 pounds per square per layer. First layer of felt shall extend out onto the roofing at least 2 inches, and each succeeding layer shall extend at least 2 inches beyond the preceding layer. Layers shall extend up the vertical surface to the sheet metal reglets, or to the top of curb when sheet metal reglets are not required, and shall be secured at the top 8 inches on center with nails or fasteners for securing roofing felts. Saturated-felt flashing sheets shall be approximately 5 feet in length and lapped not less than 6 inches with laps staggered in each layer. Mineral-surfaced roofing strips shall be cut from the width of the material, and strips shall be of sufficient length to extend from the curb onto the roof at least 2 inches beyond the widest flashing sheet. Mineral-surfaced cap sheet strips shall be installed with selvage edges at right angles to the cant. Selvage laps shall be well cemented and, where possible, shall be shingled in a direction away from the prevailing wind.

Layers of base flashing shall extend up the vertical surface to the top of curb or wall when sheet metal reglets are not required, and shall be secured at the top 8 inches on center.

Mineral-surfaced cap sheet strips shall be cut from the width of the material, and the strips shall be of sufficient length to extend from the sheet metal reglet or curb onto the roof at least 2 inches beyond the widest flashing sheet. Mineral-surfaced strips shall be installed with selvage edges at right angles to the cant. Selvage laps shall be well cemented and, where possible, shingled in a direction away from the prevailing wind.

Strip flashings: Roof flanges of lead and sheet metal flashings such as base flashings, and plumbing flashings furnished and installed under other sections of the specifications shall be stripped with layers of roofing felt. After installation of flashings over the top ply of roofing, two layers of roofing felt, 9- and 12-inches wide, shall be successively mopped on top of the roof flange to form a waterproof joint between roofing and flashings.

3.3.5 Cant Strip Application

Cant strips shall be installed in the angles formed at wall and other vertical surfaces as backing for base flashings. Fiberboard cant strips shall be laid in a solid coat of bituminous cement just prior to laying the roofing plies. Cants shall have a 5-1/2-inch face dimension, shall be

continuous, and shall be installed in as long lengths as practical.

3.3.6 Valley Application

Valleys: Roofing shall be applied at valleys and waterways in the following manner:

Base sheets shall continue across valleys and terminate at approximately 18 inches from the valley.

Felt plies shall continue across valleys and terminate at approximately 12 inches from the valley. Exposed laps shall terminate on a line approximately 12 inches from, and parallel to, the gutter valley. Two plies of felt, 9 and 12 inches wide, shall be successively mopped in over each felt line of the termination.

If the application can be completed without wrinkles, buckles, or fishmouths, and if side laps do not face the direction of drainage, roofing felts and base sheets may be laid continuously across or parallel to shallow valleys such as those formed by reverse-slope roofs. For this application, valleys shall be reinforced with one ply of felt, 36 inches wide, centered on the valley gutter and laid in a solid mopping of asphalt over the top ply of roofing.

3.3.7 Mechanical Application

When mechanical roofing-application equipment is used, planks, plywood, or other approved protection shall be placed over the roof insulation or the roofing. Traffic shall be confined to the protected area. Felt machines shall contain a sufficient quantity of bitumen at the proper temperature to ensure no holidays in the bitumen.

3.3.8 Surfacing

Provide aggregate surfacing materials after felt flashings, roof drain flashing, work of other trades, tests, repairs, and corrective action have been completed and approved. Embed aggregate surfacing in a top coat of hot asphalt poured from a dipper or approved asphalt spreading device. To aid in proper embedment, aggregate may be lightly rolled, provided that there is no damage to roofing membrane. Remove loose aggregate from roof.

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SECTION 07600

FLASHING AND SHEETMETAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants
ASTM D 4586	(1993; R 1999) Standard Specification for Asphalt Roof Cement, Asbestos Free

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-02	(1993) Architectural Sheet Metal Manual

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-04 Drawings

Fabrication Drawings for the following items shall include material, description, and thickness.

Flashing
Sheet Metal
Accessories

SD-04 Drawings

Installation Drawings shall indicate location, dimensions, configuration, construction details, type of seams and fastening

method for the following items:

Flashing
Sheet Metal
Accessories

PART 2 PRODUCTS

2.1 SHEETMETAL MATERIALS

2.1.1 Galvanized Steel

Galvanized steel sheet shall conform to ASTM A 526/A 526M, regular coating, designation Z90.

2.1.2 Corrosion-Resistant Steel

Corrosion-resistant steel shall be chromium-nickle steel conforming to ASTM A 167, Type 301, 302, 204, or 316, No. 2D finish, annealed temper as required for the end use.

2.1.3 Minimum Dimensions and Thicknesses

Materials shall be in accordance with SMACNA-02 and shall be not less than the following minimum thicknesses and weights.

ITEM	CORROSION-RESISTANT STEEL, GAGE	GALVANIZED STEEL, GAGE
Building expansion joints, cap	28	26
Bellows or flanges, U-type	28	26
Flashings		
Base	28	22
Cap, roof penetration cap flashing, equipment and structural supports, pitch pans	28	26
Cleats, 2 inches by 3 inches	26	24
Edge strips, 1-1/4 inches wide	24	20
Cap flashing receivers	28	26

ITEM	CORROSION-RESISTANT STEEL, GAGE	GALVANIZED STEEL, GAGE

2.2 CEMENTS AND SEALING COMPOUNDS

2.2.1 Bituminous Plastic Cement

Bituminous plastic cement shall be an asphaltic-base material conforming to ASTM D 4586, compatible with the roofing asphalts and asphalt primer.

2.2.2 Sealing Compound

Sealing compound shall be gun grade, one-component, nonsag, elastomeric, conforming to ASTM C 920. Base material shall be polysulfide, resistant to 50-percent joint movement.

Aluminum-seam sealant shall be as recommended by the aluminum manufacturer.

2.3 FASTENERS

Fasteners shall be the same metal or a metal compatible with the material joined.

PART 3 EXECUTION

3.1 GENERAL

Sheetmetal work shall conform to drawing details and to the applicable plate number and design and installation recommendations of SMACNA-02. Finished sheetmetal installation shall be free from water leakage.

Surfaces to receive sheetmetal work shall be clean, smooth, dry, and free from defects and projections which might affect the work. Surfaces shall be plumb and true to a tolerance of not more than 1/2 inch in 40 feet, with no dips, waves, or uneven surfaces exceeding 1/8 inch in 10 feet in any direction. Lines, arises, and angles shall be sharp and uniform. Exposed edges of sheetmetal shall be folded back to form a 1/2-inch wide hem on the concealed side.

3.1.1 Fastening Methods

Fasteners shall be concealed. Only one edge shall be nailed to permit freedom of expansion perpendicular to the line of nailing. Nails shall be spaced at not more than 3 inches on center. Nails shall penetrate backing by not less than 1 inch.

Cleats shall be used for securing edges of sheetmetal members over 12-inches wide and at other designated locations. Cleats shall be fastened with two nails and the end folded over the nails. Other end of the cleat shall be locked into the seam or the folded edge of member being fastened. Cleats shall be spaced at not more than 12 inches on center.

Screws shall be fitted with neoprene washers to protect surface of metal sheet and provide a watertight connection.

3.1.2 Seams

Seams and lock joint construction shall conform to SMACNA-02, Plates 99 or 100.

Seams shall be straight and uniform in height, width, and finish as follows:

Flat-lock seams shall be not less than 3/4-inch wide.

Lap seams shall overlap not less than 3 inches.

Loose-lock expansion seams shall be not less than 3-inches wide and shall provide for not less than a 1-inch movement within the joint. Joint shall be completely filled with the specified sealant applied at not less than 1/8-inch bed thickness.

Flat seams shall be made in the direction of flow. Seams shall be completely filled with plastic cement.

Procedures for manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work shall conform to AWS D1.1.

3.1.3 Dissimilar Metals

Dissimilar metals shall be isolated from each other by painting with bituminous paint.

3.2 FLASHING

3.2.1 Cap and Counter Flashing

Metal cap or counter flashing shall be installed where horizontal roof surfaces abut vertical wall surfaces, at copings, at joints between existing and new construction, at penetrations of roof surfaces, and at equipment supports.

Flashing shall be formed in 10-foot lengths, except where shorter pieces are required; end joints shall be lapped not less than 3 inches. Joints shall not be soldered.

3.2.2 Flashing at Roof Penetrations and Equipment Supports

Metal flashing conforming to SMACNA-02, Plate 66, shall be installed where piping, conduit, or equipment supports penetrate roof surfaces.

3.3 CLEANING

Exposed sheetmetal work shall be cleaned of all surface contaminants and imperfections at completion of installation.

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SECTION 07920

SEALANTS AND CAULKINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants

1.2 QUALITY ASSURANCE

1.2.1 Compatibility with Substrate

Sealants shall be verified for compatibility for use with joint substrates.

1.2.2 Joint Tolerance

Joint tolerances shall be in accordance with manufacturer's instructions.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered in sealed containers that identify the product, manufacturer, color, directions for use, shelf life, and curing time at 70 degrees F.

Materials shall be kept dry and shall be protected from freezing.

1.4 SPECIAL WARRANTY

Sealant joint shall be guaranteed against failure of sealant and against water penetration through each sealed joint for five years.

PART 2 PRODUCTS

2.1 BACKUP MATERIAL

2.1.1 Polyethylene

Polyethylene material shall be open cell or closed cell polyethylene as recommended by the sealant manufacturer.

2.2 BOND-PREVENTIVE MATERIAL FOR SEALING COMPOUNDS

Bond-preventive material shall be pressure sensitive tape, as recommended by the sealant manufacturer to suit application.

2.3 PRIMER-TO-SEALANT COMPOUNDS

Primer shall be non-staining type as recommended by sealant manufacturer

to suit application.

2.4 SEALANTS

2.4.1 Elastomeric

Elastomeric sealant shall be single component, color as selected, conforming to ASTM C 920, Type 5, Grade NS, Class 25, use NT,M,A,O. Base material shall be urethane.

2.5 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

Unsound substrates shall be repaired. Joint dimensions and surfaces receiving substrates shall be verified that they comply with the manufacturer's recommendations.

3.2 PREPARATION

Prepare and prime joints in accordance with manufacturer's instructions. Adjacent exposed surfaces shall be protected.

3.3 INSTALLATION

Backup material shall be installed with a blunt tool.

Backup material shall be 33 percent oversize for closed cell and at least 50 percent oversize for open cell material, unless otherwise indicated.

Multi-component sealants shall be mixed according to manufacturer's instruction and applied to ensure proper width and depth. Three-sided adhesion shall be avoided.

Sealants shall be applied within recommended temperature and humidity conditions.

Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags.

Sealant shall be installed to cover the following conditions:

Openings .25 inch and less between walls and partitions and adjacent casework, door frames, built in or surface mounted equipment and fixtures.

Perimeters of frames of doors, window, and access panels which adjoin exposed interior concrete and masonry surfaces.

Joints between interior masonry walls and partitions and columns, concrete walls, or exterior walls unless detailed otherwise.

Other interior locations where small voids between materials require filling for first class workmanship and painting.

3.4 INSPECTION AND ACCEPTANCE PROVISIONS

All work shall be inspected for proper installation. Caulking and sealing shall be rejected for the following deficiencies:

Caulking compound having a finished surface not conforming to specifications.

Sealing compound with color not matching the sample or surface not complying with specifications.

Sealing compound failing to adhere to side surfaces of joints.

3.5 CLEANING AND REPAIRING

Surfaces adjoining joint excess and smears resulting from installation shall be cleaned.

Defective work shall be removed and replaced with caulking and sealing materials as indicated.

3.6 PROTECTION

Installed sealants shall be protected until cured.

-- End of Section --

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SECTION 08100

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SECTION 08100

METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

DOOR AND HARDWARE INSTITUTE (DHI)

DHI A115.1	(1990) Preparation for Mortise Locks for 1-3/8 Inch 35 millimeter and 1-3/4 Inch 44 millimeter Doors
DHI A115.2	(1988) Door and Frame Preparation for Bored or Cylindrical Locks for 1-3/8 Inch 35 millimeter and 1-3/4 Inch 44 millimeter Doors
DHI A115.4	(1994) Standard Steel Door and Frame Preparation for Lever Extension Flush Bolts

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Standard for Fire Doors and Fire Windows

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100	(1991) Standard Steel Doors and Frames
SDOI SDI-105	(1991) Erection Instructions for Steel Frames

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Doors
Frames
Finish Hardware

Accessories

SD-04 Drawings

Fabrication Drawings for the following items shall show location and size of all holes to be punched for hardware attachment, size, shape, gage and finish.

Steel Doors
Frames

1.3 DELIVERY, HANDLING, AND STORAGE

Doors, frames, and accessories shall be protected from damage during handling, transportation, and at the job site. Materials shall be stored at the site, under cover, and on wood blocking or suitable floors.

PART 2 PRODUCTS

2.1 GENERAL

Doors, frames, and accessories shall conform to SDOI SDI-100 and the requirements specified herein.

Welding shall be in accordance with the recommended practice of the Structural Welding Code, Sections 1 through 6, AWS D1.1 and as specified by the producer of the metal being welded. Welds behind finished surfaces shall cause no distortion or discoloration on the exposed side.

2.1.1 Doors

Doors shall be heavy duty, 1-3/4-inch, 18-gage, full flush or seamless hollow steel construction, electrolytic zinc-coated with honeycomb core reinforcement.

Panel moldings on the exterior side of doors and the corridor side of interior doors shall be nonremovable. Panel molding on the interior side of doors shall be removable.

Fire-rated doors shall be the types that have been investigated and fire tested as a fire door assembly, complete with the type of fire door hardware to be used in the work. Fire-rated doors shall be labeled with the applicable fire rating of the door construction provided.

2.1.2 Frames

Interior frames shall be 16-gage full welded-unit type.

Fire-rated frames shall be the types that have been investigated and fire tested as an assembly, complete with the type of hardware to be used in the work. Fire-rated frames shall be labeled with the applicable fire rating of the frame construction provided.

2.2 FINISH HARDWARE PREPARATIONS AND LOCATIONS

Preparation for hardware shall be in accordance with DHI A115.1, DHI A115.2, and DHI A115.4, as applicable.

Frames, except fire-rated labeled frames, shall be punched to receive

molded-rubber door silencers. Single door frames shall be punched for three silencers in the lock side jamb. Double door frames shall be punched for one silencer in each leaf of the frame head. Lock strikes shall be set out to provide clearance for the silencer.

Hardware locations shall comply with SDOI SDI-100, Table V, except when template dimensions and multiple-item installations require an alternative location.

Reinforcement for finished hardware shall meet or exceed the requirements of SDOI SDI-100, Table IV.

2.3 FINISHING

Doors and frames shall be primed and finished in accordance with SDOI SDI-100.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Door Clearance

Clearances shall be those specified in SDOI SDI-100.

Clearances for fire-rated doors shall be as specified in NFPA 80.

3.1.2 Frame Installation and Tolerances

Frames shall be installed in accordance with SDOI SDI-105.

Fire-rated frames shall be installed in accordance with NFPA 80.

Frames shall be installed within the following tolerances:

Deviation in location from that indicated on the drawings	Plus or minus 1/4 inch
Deviation from plumb or horizontal:	
In 8 feet	Not more than 1/16 inch
In 12 feet	Not more than 1/8 inch

3.1.3 Finish-Hardware Installation

Hardware shall be installed and adjusted in accordance with the hardware manufacturer's printed directions.

After the installation is completed, hardware shall be adjusted and lubricated to ensure proper performance.

3.1.4 Final Adjustment

Before final acceptance, finish hardware shall be checked and readjusted as required to ensure proper operation of the finish hardware.

-- End of Section --

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SECTION 08331

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SECTION 08331

OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 53	(1999) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM D 2000	(1999) Standard Classification System for Rubber Products in Automotive Applications
ASTM A 780	(2000) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B29.1M	(1993) Precision Power Transmission Roller Chains, Attachments, and Sprockets

FEDERAL SPECIFICATIONS (FS)

FS FF-B-171	(Rev A; Am 1) Bearings, Ball, Annular (General Purpose)
FS TT-C-490	(Rev C; Am 2) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems
NEMA MG 1	(1998) Motors and Generators
NEMA ST 1	(1988; R 1994) Specialty Transformers (Except General Purpose Type)

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Wind Loading

Doors shall be designed and reinforced to withstand a wind loading pressure of at least 20 pounds per square foot with a maximum deflection of 1/120 of the opening width.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Equipment and Performance Data for the following items shall be submitted in accordance with the paragraph entitled, "Performance Requirements," of this section.

Overhead Coiling Doors
Hardware
Counterbalancing Mechanism
Door Operators

Manufacturer's Catalog Data for the following items shall be submitted listing all accessories including supports, locks and latches, and weatherstripping.

Doors
Hardware
Counterbalancing Mechanism
Electric Door Operators

SD-04 Drawings

Fabrication Drawings shall show complete assembly with hardware and framing details for the following items:

Doors
Counterbalancing Mechanism
Door Operators

SD-19, Operation and Maintenance Manuals

Contractor shall submit 6 copies of the Operation and Maintenance Manuals 30 days prior to testing the Overhead Door Assemblies. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

Operation and maintenance manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Test data shall be legible and of good quality.

1.4 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of drawings and fabrication.

1.5 WARRANTY

Contractor shall furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship and that they will remain so for not less than five years after completion and acceptance of the project.

Contractor shall warrant that upon notification by the Government, he will immediately make good any defects in material, workmanship, and door operation within the same time period covered by the guarantee, at no cost to the Government.

PART 2 PRODUCTS

2.1 DOORS

2.1.1 Curtain Construction

Curtains shall be fabricated from steel sheets conforming to ASTM A 446/A, Grade A, or to ASTM A 526/A, with the additional requirement of a minimum yield point of 33,000 psi. Sheets shall be galvanized in accordance with ASTM A 525, G90.

Doors shall be fabricated from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Slats shall be continuous without splices for the width of the door.

Slats shall be flat-profile design, with a depth not less than 0.625 inch, a center-to-center width not more than 2.75 inches, and not less than a 0.0478-inch uncoated thickness.

2.1.2 Curtain Bottom Bar

Curtain bottom bars shall be pairs of angles not less than 2.0 by 2.0 inches by 0.188 inch. Angles shall be steel conforming to ASTM A 36/A. Angles and fasteners shall be galvanized in accordance with ASTM A 525, G90. Welds and abrasions shall be coated with paint conforming to ASTM A 780.

2.1.3 Weatherstripping

Weatherstripping for door heads shall be 1/8-inchthick sheet natural rubber or neoprene rubber air baffles secured to the insides of hoods with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 5/8-inchwide and 1/8-inch thick.

Weatherstripping for door-jamb guides shall be 1/8-inch thick strip natural rubber or neoprene rubber secured to the exterior sides of jamb guides with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 5/8-inch wide and 1/8-inch thick.

Bottom astragals shall be 1/8-inch thick sheet natural rubber or neoprene rubber secured to the bottom bars.

Weatherstripping and astragals shall be natural rubber or neoprene rubber conforming to ASTM D 2000.

2.2 HARDWARE

2.2.1 Curtain Jamb Guides

Curtain jamb guides shall be fabricated from a combination of steel angles of sufficient size to retain the curtain against the specified wind loadings. Guides shall be fabricated from rolled structural-quality carbon-steel angles conforming to ASTM A 36/A. Guide assembly shall be galvanized in accordance with ASTM A 525, G90. Bolt holes shall be slotted for track adjustment. Welds and abrasions shall be coated with paint conforming to ASTM A 780.

2.2.2 Equipment Supports

Door-operating equipment supports shall be fabricated from steel shapes and plates conforming to ASTM A 36/A, galvanized in accordance with ASTM A 525, G90. Shapes and plates shall be sized in accordance with the manufacturer's standard practices for the size, weight, and type of door installation.

2.2.3 Threaded Fasteners

Threaded fasteners shall consist of unfinished low-carbon steel bolts and nuts conforming to ASTM A 307, Grade A,galvanized per ASTM A 153/A, Table 1.

2.3 COUNTERBALANCING MECHANISM

Doors shall be counterbalanced by an adjustable, steel, helical torsion spring mounted around a steel shaft in a spring barrel and connected to the door curtain with the required barrel rings.

2.3.1 Brackets

Mounting brackets shall be the manufacturer's standard with one located at each end of the counterbalance barrel.

2.3.2 Hoods

Hoods shall be fabricated from steel sheets conforming to ASTM A 446/A, Grade A, or to ASTM A 526/A, with the additional requirement of a minimum yield strength of 33,000 psi. Hoods shall be reinforced to prevent hood deflection.

2.3.3 Counterbalance Barrels

Counterbalance-barrel components shall be as follows:

Spring barrels shall be hot-formed structural-quality carbon-steel, welded or seamless pipe conforming to ASTM A 53, Type E or S, Grade A, with the steel yield point and design stresses conforming to ASTM A 36/A. Pipe shall be of sufficient diameter and wall thickness to limit deflection to a maximum of 1/360 of the span. Barrels shall be hot-dip galvanized, inside and outside, in conformance with ASTM A 525, G90.

Counterbalance springs shall be oil-tempered helical steel springs designed with a safety factor of not less than 4. Springs shall be sized to counterbalance the weight of the curtain at any point of its travel, and shall be capable of being adjusted to counterbalance not less than 125 percent of the normal curtain load. Spring adjustment shall be arranged in such a way that the curtain need not be raised or lowered to secure the adjustment.

Counterbalance shafts shall be case-hardened steel of the proper size to hold the fixed ends of the spring and carry the torsional load of the spring.

Barrel plugs shall be fabricated from cast steel machined to fit the ends of the barrel. Plugs shall secure the ends of the spring to the barrel and the shaft. Plugs shall be galvanized in conformance with ASTM A 525, G90.

Barrel rings shall be fabricated from malleable iron of the proper involute shape to coil the curtain in a uniformly increasing diameter.

Shaft bearings shall be factory-sealed ball bearings conforming to FS FF-B-171 and of the proper size for load and shaft diameters.

2.4 ELECTRIC DOOR OPERATORS

Electrical wiring shall conform to the applicable requirements of Section 16145, "Standard Wiring Systems."

Door operator controls shall conform to the applicable requirements of Section 16286, "Overcurrent Protective Devices."

Electric door-operator assemblies shall be the sizes and capacities recommended and provided by the door manufacturer for specified doors. Assemblies shall be complete with electric motors and factory-prewired motor controls, gear reduction units, solenoid-operated brakes, clutches, remote-control stations, manual or automatic control devices, and control of stations and accessories as required for proper operation of the doors.

Operators shall be so designed that motors may be removed without disturbing the limit-switch adjustment and without affecting the emergency auxiliary operators.

A manual operator of crank-gear or chain-gear mechanisms with a release clutch shall be provided to permit manual operation of doors in case of power failure. Emergency manual operator shall be so arranged that it may be put into and out of operation from floor level, and its use shall not affect the adjustment of the limit switches. An electrical or mechanical device shall be provided which will automatically disconnect the motor from the operating mechanism when the emergency manual operating mechanism is engaged.

2.4.1 Door-Operator Types

Door operators shall be wall-mounted units consisting of an electric motor, a worm-gear drive from the motor to the reduction gear box, a chain or worm-gear drive from the reduction gear box to the gear wheel mounted on the counterbalance shaft, and a quick-clutch disconnect release for manual operation. Motor, clutch, and drive assembly shall be the horsepower rating and design determined by the door manufacturer for the size of the door and as specified.

2.4.2 Motors

Motors shall be the high-starting-torque, reversible, constant-duty electrical type with overload protection. Motors shall be of sufficient torque and horsepower to move the door in either direction from any position and produce a door-travel speed of not less than 8 nor more than

12 inches per second without exceeding the horsepower rating.

Motors shall conform to NEMA MG 1 and to the requirements specified.

Motors shall be three-phase 230/460-volt, 60-hertz. Motor frame sizes shall conform to NEMA MG 1. Motor enclosures shall be open drip-proof and shall be certified for continuous operation at full nameplate power output in an ambient temperature of 104 degrees F.

2.4.3 Motor Bearings

Bearings shall be bronze-sleeve or heavy-duty ball or roller antifriction type with full provisions for the type of thrust imposed by the specific duty load.

Motors coupled to worm-gear reduction units shall be equipped with either ball or roller bearings.

Bearings in motors shall be equipped with lubrication service fittings. Lubrication fittings shall be fitted with color-coded plastic or metal dust caps.

In any motor, bearings that are lubricated at the factory for extended duty periods shall not need to be lubricated for a given number of operating hours. An appropriate tag or label on the motor shall display this information.

2.4.4 Motor Starters, Controls, and Enclosures

Each door motor shall have a factory-wired, unfused, disconnect switch; a reversing, across-the-line magnetic starter with thermal overload protection; 120-volt operating coils with a control transformer limit switch; and a safety interlock assembled in a NEMA ICS 6 type enclosure as specified herein.

Adjustable switches, electrically interlocked with the motor controls and set to stop the door automatically at the fully open and fully closed position, shall be provided.

2.4.5 Control Enclosures

Control enclosures shall conform to NEMA ICS 6 for oiltight and dusttight NEMA Type 13.

2.4.6 Transformer

Starters with 230/460 to 115 volt control transformers with one secondary fuse shall be provided when it is required to reduce the voltage on control circuits to 120 volts or less. Transformers shall conform to NEMA ST 1.

2.4.7 Safety-Edge Device

Each door shall be provided with a pneumatic safety device extending the full width of the door and located within a U-section neoprene or rubber astragal mounted on the bottom rail of the bottom door section. Device shall immediately stop and reverse the door upon contact with an obstruction in the door opening during downward travel and shall cause the door to return to full-open position. Safety device shall not be a substitute for a limit switch.

Safety device shall be connected to the control circuit through a retracting safety cord and reel.

2.4.8 Remote-Control Stations

Remote-control stations shall be full-guarded, momentary-contact three-button, heavy-duty, surface-mounted NEMA ICS 6 type enclosures as specified. Buttons shall be marked "OPEN," "CLOSE," and "STOP." The "CLOSE" button shall be the type requiring a constant pressure to maintain the closing motion of the door. When the door is in motion and the "STOP" button is pressed, the door shall stop instantly and remain in the stopped position; from the stopped position, the door may then be operated in either direction.

2.4.9 Speed-Reduction Units

Speed-reduction units shall consist of hardened-steel worm and bronze worm gear assemblies running in oil or grease and encased in a sealed casing, coupled to the motor through a flexible coupling. Drive shafts shall rotate on ball- or roller-bearing assemblies that are integral with the unit.

Minimum ratings of speed reduction units shall be in accordance with AGMA provisions for class of service.

Worm gears shall be ground to provide accurate thread form; all other types of gearing shall have machined teeth. All gears shall be surface hardened.

Bearings shall be the antifriction type equipped with oil seals.

2.4.10 Chain Drives

Roller chains shall be power-transmission series steel roller type conforming to ASME B29.1M, with a minimum safety factor of 10 times the design load.

Roller-chain side bars, rollers, pins, and bushings shall be heat-treated or otherwise hardened.

Chain sprockets shall be high-carbon steel with machine-cut hardened teeth, finished bore and keyseat, and hollow-head setscrews.

2.4.11 Brakes

Brakes shall be internally expanding 360-degree shoe brakes or shoe and drum brakes, solenoid-operated and electrically interlocked to the control circuit to set automatically when power is interrupted.

2.4.12 Clutches

Clutches shall be the 4-inch diameter, multiple face, externally adjustable friction type or adjustable centrifugal type.

2.5 SURFACE FINISHING

Zinc-coated steel materials shall be chemically cleaned, rinsed, given a zinc-phosphate conversion coating, rinsed with cold water, and then sealed with a chromic-acid rinse in accordance with FS TT-C-490, Method III, Type

I. Minimum weight of the pretreatment coating shall be not less than 150 milligrams per square foot.

Pretreated zinc-coated steel sheets shall be given the manufacturer's standard prime coat of paint applied to both faces of the door after forming.

PART 3 EXECUTION

3.1 GENERAL

Doors, tracks, and operating equipment shall be installed complete with specified preparatory framing, jamb and head mold stops, anchors, inserts, hangers, and equipment supports in accordance with approved drawings, manufacturer's printed instructions, and as specified.

Door guide-track assembly shall be fastened to steel or wood framing with 1/2-inch galvanized machine bolts or lag screws, not more than 24 inches on center, and erected plumb and true to a vertical alignment with not more than 1/8 inchdeviation in 20 feet.

3.2 STEEL FRAMING

Steel framing at jambs and heads of door openings shall be plumb, true, and securely anchored in place. Vertical members shall be plumb, with a deviation of not more than 1/16 inch in 20 feet. Inside faces of steel jambs shall extend to the ceiling or to the minimum headroom height of the door.

3.3 ACCEPTANCE PROVISIONS

After installation, doors, track, and operating equipment will be examined and tested by the Government for general operation, for operation against the specified wind pressure, and for resistance to weather.

Doors that fail the required tests shall be adjusted and retested. Doors that have been adjusted and which fail subsequent tests shall be removed and replaced with new doors. New doors shall be tested and adjusted at no additional cost to the Government.

3.3.1 Maintenance and Adjustment

Not more than 90 days after completion and acceptance of the project, the Contractor shall examine, lubricate, test, and re-adjust doors as required for proper operation.

-- End of Section --

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DIVISION 08 - DOORS & WINDOWS

SECTION 08333

METAL ROLLING COUNTER DOORS

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SECTION 08333

METAL ROLLING COUNTER DOORS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 240/A 240M	(1999b) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

1.2 GENERAL

Rolling counter doors shall be of the type, size, and design indicated on the drawings, and shall be the standard product of a manufacturer regularly engaged in the production of rolling counter doors. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model number of the door.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Rolling Counter Doors

Manufacturer's descriptive data and catalog cuts.

Manufacturer's preprinted installation and cleaning instructions.

SD-04 Drawings

Approved Detail Drawings

Drawings showing elevations of each door type, details of anchorage, details of construction, location and description of hardware, shape and thickness of materials, details of joints and connections, and details of guides and fittings.

1.4 DELIVERY AND STORAGE

Rolling counter doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Rolling counter doors shall be stored in accordance with the manufacturer's instructions in a dry location that is adequately ventilated and free from

dust, water, or other contaminants, and in a manner that permits easy access for inspecting and handling. Doors shall be handled carefully to prevent damage. Damaged items that cannot be restored to like-new condition shall be replaced.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 BASIC COMPONENTS

2.1.1 Curtain

The curtain shall be fabricated of 22 gauge Type 304 stainless steel slats conforming to ASTM A 240/A 240M. Thickness of slat material shall be as required by width of opening. Slats shall be approximately 1-1/4 to 1-1/2 inch wide with a depth of crown of 1/2 inch. Alternate slats shall be fitted with end locks to maintain curtain alignment. Bottom of curtain shall be provided with angle or tubular bar reinforcement matching the curtain, and fitted with a resilient bottom seal.

2.1.2 Jamb Guides

Guides shall be of 13 gauge minimum thickness stainless steel conforming to ASTM A 240/A 240M, Type 304 or Type 430.

2.1.2.1 Sill

The sill shall be fabricated of 14 gauge Type 304 stainless steel formed shape.

2.1.3 Counterbalance Shaft Assembly

The curtain shall be coiled around a steel tube of sufficient thickness and diameter to prevent deflection exceeding 0.03 inch per foot. The barrel shall contain oil tempered helical steel torsion springs capable of sufficient torque to counterbalance the weight of the curtain. Springs shall be calculated to provide a minimum of 7,500 operating cycles (one complete cycle of door operation will begin with the door in the closed position, move to the full open position and return to the closed position).

2.1.4 Brackets

Brackets shall be a minimum 12 gauge thickness steel if flat plate, or 16 gauge thickness if there are a minimum of 3 returns of 3/4 inch width.

2.1.5 Hood

The hood shall be of 24 gauge stainless steel conforming to ASTM A 240/A 240M, Type 304 or Type 430, No. 4 finish.

2.1.6 Locks

The curtain shall be locked at each side of the bottom bar by an integral slide bolt suitable for padlocks by others. Lock shall be on the Test Area room side of the counter door.

2.2 ROLLING COUNTER DOOR (NON-RATED)

Rolling counter doors shall conform to the requirements specified herein and shall be constructed of stainless steel curtains, guides and hood components.

2.3 OPERATION

2.3.1 Manual Operation

The curtain shall be operated by means of manual crank with removable handle.

2.4 FINISH

Exposed parts of the counter door, including the curtain, bottom rail, guides, and hood shall be of uniform finish and appearance. Stainless steel shall have a No. 4 finish.

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

3.2 CLEANING

Stainless steel doors shall be cleaned in accordance with manufacturer's approved instructions.

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DIVISION 08 - DOORS & WINDOWS

SECTION 08520

ALUMINUM WINDOWS

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SECTION 08520

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	(1997) Voluntary Guide Specifications for Aluminum and Polyvinylchloride (PVC) Prime Windows and Sliding Glass Doors
AAMA WSG-1	(1988) Selection Guide for Architectural Aluminum Windows

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1994) Standard Test Method of Salt Spray (Fog) Testing
ASTM B 244	(1998) Standard Classification of Coppers

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3110G	(1992) Primer, Zinc Chromate

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 101	(1991) Aluminum Alkyd Paint Leafing (Type I) and Non-Leafing (Type II)
SSPC Paint 12	(1991) Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick Film)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items, including operating hardware, locking assemblies and strikes, pole and sash operators and weatherstripping.

Thermal Barrier Windows
Mullions

SD-04 Drawings

Fabrication Drawings shall show complete window assembly including hardware, weatherstripping, and subframe assembly details for Aluminum Window Units.

1.3 DELIVERY, HANDLING, AND STORAGE

Windows, mullions, accessories, and trim shall be delivered in the manufacturer's unbroken containers and shall be handled carefully at all times to prevent damage.

Windows shall be stored on edge above ground and protected from the weather in accordance with the manufacturer's directions.

1.4 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of the drawings and fabrication.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Wind Loading Design Pressure

Window components, including mullions, hardware, and anchors, shall be designed to withstand a wind-loading design pressure of at least 25 pounds per square foot (psf).

1.5.2 Tests

Windows proposed for use shall be tested in accordance with AAMA 101 for the particular type and quality window specified.

Tests shall be performed by a nationally recognized independent testing laboratory equipped and capable of performing the required tests. Results of the tests shall be submitted as certified laboratory reports required herein.

Minimum design load for a uniform-load structural test shall be 50 psf.

Projected windows shall be tested in accordance with the applicable portions of the AAMA WSG-1 for air infiltration, water resistance, uniform-load deflection, and uniform-load structural test.

PART 2 PRODUCTS

2.1 FIXED WINDOWS

Fixed windows, complete with accessories and fittings, shall be provided where indicated.

Material and construction shall be as specified except as follows:

Aluminum alloy shall be 6063-T6.

Frame construction shall be factory-assembled.

Window unit shall be factory-glazed with the type of glass indicated and of the quality specified in Section 08805, "Glass and Glazing."

2.2 MULLIONS

Mullions shall be provided between multiple-window units where indicated.

Mullions and mullion covers shall be the profile indicated, reinforced as required for the specified wind loading, and securely anchored to the adjoining construction. Mullion extrusion shall include serrations or pockets to receive weatherstripping, sealant, or tape at the point of contact with each window flange.

Mullion assembly shall include aluminum window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover shall be screw-fastened to the mullion unless otherwise indicated.

Mullion reinforcing members shall be steel or aluminum shapes provided by the window manufacturer to meet the specified design loading.

2.3 FINISH

Aluminum window, mullions, glazing beadings, trim, and accessory fittings shall be thoroughly cleaned and shall receive an Architectural Class I natural anodic coating (designation AA-M-12C22A41) in accordance with AA DAF-45. Anodic-coating thickness shall be not less than 0.7 mil.

Thickness of the anodic coating shall be tested in accordance with ASTM B 244.

Anodic coating shall be continuous and, without being lacquered, shall be capable of withstanding 500 hours of salt-spray exposure for Class A anodic coatings and 250 hours of salt-spray exposure for Class B anodic coatings when tested in accordance with ASTM B 117.

PART 3 EXECUTION

3.1 INSTALLATION

Windows shall be set plumb, level to a tolerance of not more than 1/16 inch in 10 feet and in alignment without frame distortion and securely anchored in place as indicated, in accordance with the manufacturer's printed instructions and the approved drawings.

Fasteners shall be concealed except for specifically indicated mullion covers, window-operating hardware, screen attachment hardware, and similar surface-applied trim.

Ventilators and operating parts shall be protected against cement, lime, plaster, adhesives, and other building material after installation and until completion.

Steel work shall be drilled and tapped for the attaching window units, trim, and accessories. Where window units are set in prepared masonry openings, anchorage items shall be placed during wall construction. Anchors and fasteners shall be welded or bolted securely to the frame and shall be built-in, anchored, or bolted to the building construction with sufficient anchors to hold each window unit firmly in place. Anchors shall be not more than 18 inches on center at heads, jambs, and sills.

Fasteners, clips, fittings, aluminum trim, closures, and shapes shall be provided as indicated and as required to provide a complete installation.

Joints shall be sealed between sash units, aluminum sills, mullions, and covers and similar metal-to-metal contact surfaces with sealant or tape as recommended and furnished by the window manufacturer. Installations shall be weathertight.

Joint sealing and calking between metal and masonry is specified in Section 07920, "Sealants and Calkings."

3.2 DISSIMILAR MATERIALS

Aluminum shall be kept from direct contact with steel or other dissimilar materials by painting, nonabsorptive tape, gasket, or other approved system as recommended by the manufacturer and as specified.

Aluminum surfaces in contact with steel shall be given one coat of zinc-chromate primer conforming to SAE AMS 3110G, applied to a dry-film thickness of not less than 1.5 mils, or one coat of a suitable nonhardening joint compound capable of excluding moisture from the joint during prolonged service.

Steel surfaces in contact with aluminum shall be given one coat of zinc-chromate paint conforming to SAE AMS 3110G, applied to a dry-coat thickness of 1.5 mils, and two or more coats of aluminum paint conforming to SSPC Paint 101, aluminum alkyd, Type II, applied to a dry-film thickness of 1.5 mils for each coat and a total dry-film thickness of 3.0 mils.

Corrosion-resistant, aluminized, or hot-dip galvanized steel placed in contact with aluminum need not be painted.

Aluminum surfaces placed in contact with wood, concrete, or masonry construction shall be given one coat of bituminous paint conforming to SSPC Paint 12, applied to a thickness of at least 1/16 inch.

3.3 CLEANING AFTER INSTALLATION

Interior and exterior metal surfaces of windows shall be cleaned of mortar, plaster, paint spattering or spots, and other foreign matter, and washed with soap and water, brushed with a fiber brush, and thoroughly rinsed with clear water. Acid solutions, steel wool, or other harsh abrasives shall not be used.

Stained or discolored windows shall be cleaned in accordance with the window manufacturer's recommendations. Windows that cannot be satisfactorily cleaned and windows with abraded, stained, or defective surface finish that cannot be satisfactorily repaired shall be replaced.

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SECTION 08710

DOOR HARDWARE

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SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(1997) Butts and Hinges
BHMA A156.13	(1994) Mortise Locks and Latches
BHMA A156.16	(1997) Auxiliary Hardware
BHMA A156.18	(1993) Materials and Finishes
BHMA A156.2	(1989) Bored and Preassembled Locks and Latches
BHMA A156.21	(1989) Thresholds
BHMA A156.3	(1994) Exit Devices
BHMA A156.4	(1992) American National Standards for Door Controls - Closers
BHMA A156.5	(1992) Auxiliary Locks & Associated Products

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100	(1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL-02	(2001) Building Materials Directory

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Fasteners
Hinges
Locksets

Lever Extension Flush Bolts
Closers
Coordinating Device
Door Holders
Door Stops
Door Silencers

SD-07 Schedules

A Finish Schedule shall include a Hardware Schedule indicating the door and frame location, type, size, swing, bevel, material, hardware type by Builders' Hardware Manufacturers Association (BHMA) numbers, and the respective manufacturer's type, name, number, finish, and design, Material, Equipment and Fixture Lists shall be provided prior to the hardware schedule, showing a list of the proposed Finish Hardware by manufacturer, type, name, series, material and finish.

PART 2 PRODUCTS

2.1 FASTENERS

Fasteners of the proper type, size, quantity, and finish for each hardware item shall be provided. All visible fasteners shall be phillips-head, bronze or stainless steel finished to match specified hardware.

2.2 HINGES

Hinges shall be full mortise, heavy weight, anti-friction bearing, button tip, template type conforming to BHMA A156.1, Grade 1. Size shall be 4-1/2 by 4-1/2 inches.

2.3 LOCKSETS

2.3.1 General

Cylinder bored locksets and latchsets shall conform to BHMA A156.2, plain design and wrought trim.

Mortise locksets and latchsets shall conform to BHMA A156.13.

Locksets and latchsets shall have standardized fronts, cases, and strikes so that varying functions will be interchangeable and will require only one mortise for their installation. Locks and latches shall have beveled bronze fronts, bronze bolts and strikes, brass hubs, and cases with specified finish. Locks shall have cylinders conforming to BHMA A156.5.

Locksets and lock cylinders shall be masterkeyed to Langley Research Center's established Best Lock Co., Universal Masterkey system.

2.3.2 Mortise Locksets

Mortise locksets and latchsets for fire-rated doors shall be UL listed and labeled, heavy duty, Series 1000, Grade 1.

Heavy duty usage mortise locksets and latchsets shall be Series 1000, Grade 1.

2.4 THRESHOLDS

Thresholds shall be extruded aluminum 6063-alloy mill finish conforming to BHMA A156.21, Type J601 (corrugated).

Thresholds shall be provided for the full width of the opening at exterior doors.

2.5 LEVER EXTENSION FLUSH BOLTS

Flush bolts shall be cast or extruded brass or steel, specified finish, conforming to BHMA A156.16, with 12-inch lever extensions.

Flush bolts shall be a type listed in UL-02 for fire-rated doors.

2.6 CLOSERS

Closers shall conform to BHMA A156.4.

Closers shall be the surface mounted heavy duty, parallel arm type, Grade 1. Style shall be modern.

Hold-open devices shall be provided on all closers except labeled doors.

Brackets, reinforcing plates, and accessory fittings shall be provided as required.

2.7 ASTRAGALS

Astragals shall be prime steel, 13-gage minimum by 1-5/8-inch side minimum.

2.8 COORDINATING DEVICE

A coordinating device shall be provided for each pair of doors with an overlapping astragal or with rabbeted stiles.

Coordinating devices shall conform to BHMA A156.3, bronze or stainless steel, finish to match the locksets.

2.9 MISCELLANEOUS AND SHELF HARDWARE

2.9.1 General

Miscellaneous hardware shall conform to BHMA A156.16, except as noted, and shall match or have the same finish as lockset finish.

2.9.2 Door Holders

Door holders shall be lever type with replaceable rubber tip, Type L01381.

2.9.3 Door Stops

Door stops and bumpers shall conform to BHMA A156.16.

Wall mounted stops shall be Type L02101 (wall bumper). Where impossible to install wall mounted stops, floor mounted stops, Type L02141 (dome type) or Type L02161 (dome type for door with thresholds) shall be provided.

2.9.4 Door Silencers

Door silencers conforming to BHMA A156.16 shall be provided except on fire-rated door frames.

Door silencers shall be Type L03011 for metal frames.

2.10 WEATHERSTRIPPING MATERIALS

2.10.1 Door-Sill Weatherstripping

Weatherstripping shall consist of a 1/8-inch thick by 1-3/8-inch-high neoprene strip housed in an extruded, anodized aluminum housing approximately 0.070-inch thick by 1-1/4-inches high by the full width of the door and attached to the door with countersunk screws.

2.11 FINISHES

Hardware shall receive the following finish(es) conforming to BHMA A156.18, as follows:

Hinges, locksets and latchsets	Satin stainless steel, BHMA Code 630
Hinges at labeled openings	Satin chromium plated on steel, BHMA Code 652
Closers	Sprayed, matching locksets and latchsets
Lever extension flush bolts	Satin aluminum, clear anodized, BHMA Code 628
Door stops, door holders, weatherstripping, astragals	Match locksets and latchsets

Aluminum hardware items shall be anodized to an Architectural Class II natural finish not less than 0.4-mil thick conforming to AA DAF-45 (designation AA M21 C22 A31).

PART 3 EXECUTION

3.1 GENERAL

Hardware shall be installed and adjusted in accordance with the hardware manufacturer's printed instructions and to template dimensions.

Temporary-construction cores shall be furnished, installed, and maintained in locks during construction and removed when directed.

3.2 HARDWARE LOCATION

Hardware shall be located in accordance with SDOI SDI-100, Table V, except when template dimensions and multiple-item installations require alternate locations.

3.3 HARDWARE SCHEDULE

Hardware Set No. 1
(Door No. 1 & 3)

3 Pair Hinges	A8112 4-1/2 x 4-1/2 x 652
1 Each Lockset	Series 4000, Grade 1, F82
2 Each Closer/Coordinator/hold open	Dorma TS93 GSR/EMF, or Equal
1 Set Flush Bolts	As Specified
1 Each Astragal	As Specified

Hardware Set No. 2
(Door No. 2,5,7,8, & 9)

1-1/2 Pair Hinges	A8112 4-1/2 x 4-1/2 x 652
1 Each Lockset	Series 4000, Grade 1, F84
1 Each Closer	As Specified

Hardware Set No. 3
(Door No. 6)

3 Pair Hinges	A8112 4-1/2 x 4-1/2 x 639
1 Each Lockset	Series 4000, Grade 1, F84
2 Each Closer/Coordinator/hold open	Dorma TS93 GSR/EMF, or Equal
1 Set Flush Bolts	As Specified
1 Each Astragal	As Specified

Hardware Set No. 4

3 Pair Hinges	A8112 4-1/2 x 4-1/2 x 639
1 Each Lockset	Series 4000, Grade 1, F75
2 Each Closer	As specified
1 Set Flush Bolts	As Specified
1 Each Astragal	As Specified

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DIVISION 08 - DOORS & WINDOWS

SECTION 08805

GLASS AND GLAZING

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SECTION 08805

GLASS AND GLAZING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 800	(1992) Voluntary Specifications and Test Methods for Sealants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) American National Standards for Safety Glazing Material Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036	(1991; R 1997) Standard Specification for Flat Glass
ASTM C 669	(1995) Standard Specification for Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants

FLAT GLASS MARKETING ASSOCIATION (FGMA)

FGMA-01	(1990) Glazing Manual

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items showing conformance with the referenced standards and tests contained in this section.

Glass Materials
Glazing Materials
Tempered Glass

1.3 DELIVERY, STORAGE AND HANDLING

Manufactured glass units shall be delivered and stored until installation in the manufacturer's container's and shall be clearly marked on the exterior as to type, and quantity of units.

When special moisture protection is required, glass shall be stored in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.1 GLASS MATERIALS

2.1.1 Clear Glass

Glass shall be float type conforming to ASTM C 1036, Type I, Class 1, Quality q3.

Maximum allowable areas of glass subject to wind pressure shall conform to the glass manufacturer's recommendations.

2.1.2 Safety-Rated Tempered Glass (For Door Lights)

Glass shall conform to ANSI Z97.1 and shall bear the ANSI safety glass marking.

Glass before tempering shall be the float type conforming to ASTM C 1036, Type I, Class 1, Quality q3.

Glass shall be factory-cut to suit each opening. Edges shall be clean cut.

2.1.3 Clear Sheet Glass (For Window Units)

Glass shall conform to ASTM C 1036, Type II, Class 1.

Maximum allowable areas of glass subject to wind pressure shall conform to the glass manufacturer's recommendations.

Clear sheet glass shall be double strength.

2.2 GLAZING MATERIALS

2.2.1 Elastic Glazing Compound

Elastic glazing compound shall conform to ASTM C 669.

Color of the sealing compound shall match the color of the metal sash as closely as possible.

2.2.2 Glazing Tape

Tape shall be nonskinning, nonoily, reinforced class, butyl- or polyisobutylene-base resilient preformed compound conforming to AAMA 800.

2.2.3 Elastomeric Sealing Compound

Compound shall be the two-component, nonsag type, resistant to 50 percent total joint movement, conforming to ASTM C 920, Type S NS, Class 25.

Compound shall match the color of the metal sash as closely as possible.

Primer for the compound shall be as recommended by the elastomeric sealing compound manufacturer.

2.2.4 Solvents and Cleaning Agents

Solvents, cleaning agents, and other cleaning materials shall be as recommended by the glazing-material manufacturer.

2.2.5 Glazing Clips

Clips shall be zinc-coated or copper-clad spring-steel wire or nonferrous metal and shall be the type, sizes, and shapes suitable for the intended use.

2.2.6 Resilient Setting Blocks and Spacers

Blocks shall be solid chloroprene elastomeric extrusions having a Shore A durometer hardness between 70 and 90. Thickness shall be approximately the same as the glass-edge clearance dimension; the length shall be 4 inches, minimum.

Spacers shall be solid chloroprene elastomeric extrusions having a Shore A durometer hardness between 40 and 50. Spacers shall be 2- to 3-inches long with thickness and height to suit the application.

PART 3 EXECUTION

3.1 GENERAL

Glass shall be installed in accordance with the manufacturer's printed instructions.

Field cutting, or nipping or grinding the edges of glass will not be permitted.

Sheet glass shall be installed with the wave horizontal.

Sizes of glass shown on drawings are approximate. Sizes and proper edge clearances shall be determined by measuring the actual unit to receive glass. Except where specified otherwise, each piece of glass shall bear the manufacturer's label to identify its type as well as thickness and quality. Labels shall not be removed until final approval by the Contracting Officer is obtained.

3.2 TEMPERATURE CONDITIONS

Glazing materials shall not be installed when the ambient temperature is below 40 or above 100 degrees F.

Exterior glazing shall not be performed in damp or rainy weather.

3.3 CLEARANCES AND POSITIONING GLASS

Face and edge clearances and positioning glass with setting blocks and spacers shall be as recommended in the FGMA-01.

3.4 APPLICATION OF GLAZING COMPOUNDS

Glazing compounds shall be installed in accordance with the manufacturer's printed instructions and as follows:

Elastic glazing compound shall be knife-applied as it comes from the container, without adulteration.

Glazing tape shall be compressed slightly to obtain a positive bond and neatly mitered or butted at corners. Backing paper shall be removed prior to installation of the glass.

Elastomeric sealing-compound components shall be mixed. Compound shall be gun-applied to fill the cavity without air pockets.

3.5 SINGLE GLASS IN METAL SASH WITH FACE GLAZING

Single-glass lights up to 50 united inchesin size, with the greatest dimension not exceeding 30 inches, shall be set in metal sash with elastic glazing-compound back bed, heel bead, and front putty.

Single-glass lights between 50 and 100 united inches in size, with the greatest dimension between 30 and 50 inches,, shall be set in metal sash with a glazing-tape back bed, an elastic-glazing compound heel bead, and front putty.

Glass lights shall be secured with glazing clips placed at sill, head, and jambs 18 inches on center, minimum. Each ventilator shall be provided with a minimum of four glazing clips.

Front of each glass light edge in the sash rabbet shall be face-puttied with elastic glazing compound to form a triangular fillet, stopping 1/16 inch short of the sight line. Corners shall be mitered finish and excess compound shall be removed. Surplus back-bed material shall be stripped at an angle without undercutting.

3.6 GLASS PROTECTION

Glazed openings shall be identified during the construction period by tapes or flags that are not in contact with the glass.

Temporary labels shall be removed immediately after the glass and glazing work has been approved.

3.7 CLEANING

Upon completion of work, glass surfaces shall be cleaned and shall be free of glazing- or sealing-compound, smears, and other defacement.

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DIVISION 09 - FINISHES

SECTION 09514

ACOUSTIC CEILINGS, EXPOSED GRID

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-- End of Section Table of Contents --

SECTION 09514

ACOUSTIC CEILINGS, EXPOSED GRID

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	(1996) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 591/A 591M	(1989; R 1994) Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications
ASTM B 633	(1985; R 1994) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 423	(1990; Rev A) Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 635	(1994) Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1992) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 1264	(1990) Standard Classification for Acoustical Ceiling Products
ASTM E 90	(1990) Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Noise Reduction Coefficient Grade

Noise reduction coefficient (NRC) grade of acoustic ceilings shall be tested or certified by an approved testing laboratory in accordance with ASTM C 423, and shall be as follows:

MOUNTING TYPE	NRC GRADE

No. 7	0.50 to 0.60

1.2.2 Ceiling Sound-Transmission Classification

Sound Transmission Classification (STC) of the indicated acoustic ceilings shall be an 11-frequency test method conforming to ASTM E 90, and shall be as follows:

CONDITION AT PARTITIONS	CEILING STC
Interrupted	35 to 39

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items showing UL classification of fire-rated ceilings giving materials, construction details, types of floor and roof constructions to be protected, and UL design number and fire protection time rating for each required floor or roof construction and acoustic ceiling assembly.

Acoustic Materials
Suspension System

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered and stored in their original, unopened packages bearing labels clearly identifying manufacturer's name, brand name, material, type or class, UL listing when applicable, and other pertinent data.

Acoustic materials shall be stored in a weathertight and dry place, having a temperature not less than 65 degrees F and relative humidity not more than 70 percent, and for at least 24 hours prior to installation.

1.5 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of drawings and fabrication, to ensure proper fitting of the work.

1.6 MAINTENANCE INSTRUCTIONS

The Contractor shall follow the acoustic material manufacturer's recommended cleaning and application methods, including precautions in the use of cleaning materials that may be detrimental to acoustic surfaces and the finish of exposed metal components.

PART 2 PRODUCTS

2.1 ACOUSTIC MATERIALS

2.1.1 Mineral Fiber Acoustic Units

Units shall be prefabricated, mineral-composition type, not more than 25 flame spread index class and 0.75 or more light reflectance coefficient grade, conforming to ASTM E 1264.

Finish of exposed-to-view surfaces of the units shall be a factory-applied, washable, white paint scuff-resistant and washable white finish, consisting of two paint coats and one vinyl coat.

2.1.2 Acoustic Panels

Panels shall be mineral-fiber units, nominal 24 by 24 inches by not less than 5/8 inch thick, with square trimmed and butt edges.

Pattern shall be in accordance with ASTM E 1264, fissured.

2.2 SUSPENSION SYSTEM MATERIALS

2.2.1 Zinc-Coated, Cold-Rolled Steel Sheets

Steel sheets shall be carbon steel conforming to ASTM A 366/A 366M, with not less than 0.00015-inch electrodeposited zinc coating conforming to ASTM B 633 electrolytic-zinc-coated steel sheets of carbon steel with Class C zinc coating conforming to ASTM A 591/A 591M.

2.2.2 Cross Runners

Cross runners shall be designed for use with the type and structural classification of the main runners used, in accordance with ASTM C 635. Cross runners shall be fabricated from specified steel sheets not less than 0.0179-inch thick. The bottom flange shall be suitable for the tile joint used.

Exposed cross runners shall be T-sections fabricated of the same metal as the exposed main runners, and shall be designed for use with the type and structural classification of the main runners used in accordance with ASTM C 635. Web height shall be not less than 15/16 inch. The bottom flange width shall be the same as that of the exposed main runner used. The cross runners shall have web ends designed for tab-lock attachment to adjoining cross runners through the web of the exposed main runner to provide alignment with a minimum of torsional movement and lateral displacement.

Finish of the exposed-to-view surfaces shall be baked-on white enamel . Finish shall pass the high humidity test specified in ASTM C 635.

2.2.3 Exposed, Direct Hung, Main Runners

Main runners shall be cold-formed bulb-tee sections, single- or double-web type, fabricated from specified steel sheets. Web height shall be not less than 1-1/2 inches, and the bottom flange width not less than 15/16 inch. Webs shall be drilled or grooved to receive cross runner end tabs and main runner splices.

The structural classification shall be light duty in accordance with ASTM C 635. Steel sheets shall be not less than 0.0209-inch thick.

Finish of the exposed-to-view surfaces shall be baked-on white enamel. Finish shall pass the high humidity test specified in ASTM C 635.

2.2.4 Wall Moldings

Moldings shall be angle-shape sections fabricated from specified aluminum sheets not less than 0.050 inch thick.

Height of moldings shall be as required to accommodate the type of runners used. Where exposed main runners are used, the exposed leg width of moldings shall be the same as the flange width of the runners. Where bullnose masonry units are used for wall and partition construction, inside-and outside-corner caps shall be provided. Corner caps shall be one-piece, shop-fabricated units having a radius conforming to the bullnose and exposed face width the same as the exposed width of the adjoining wall molding. Corner caps shall extend at least 12 inches on each side of the corner, and shall be butt-joined to the adjacent wall molding with concealed fastenings.

Finish of exposed-to-view surfaces of moldings and corner caps shall be the same as the runners.

2.3 SUSPENSION MATERIALS

2.3.1 Hanger Inserts

Hanger Inserts shall be as follows:

Inserts shall consist of a wire loop and steel shell embedded in concrete and designed to provide a single wire loop exposed flush with the concrete surface. Wire shall be galvanized carbon steel not less than 0.177 inch in diameter. Shell shall be formed from galvanized carbon steel sheets, not less than 0.0179-inch thick.

Inserts shall not be removable when embedded in concrete of 3,000 pound-per square-inch compressive strength and subjected to a 300-pound tension load test in an axial direction; nor shall the concrete show evidence of failure attributed to the hanger insert.

2.3.2 Hanger Wire

Hangar wire shall be 12-gage galvanized, soft annealed, mild steel wire in accordance with ASTM C 636.

PART 3 EXECUTION

3.1 ACOUSTIC MATERIAL

Acoustic material shall be installed in accordance with the manufacturer's recommendations.

3.2 CONDITIONS AT BUILDING

Work above the ceiling line shall be completed, and approved, prior to the start of acoustic work.

Spaces to receive acoustic materials shall be maintained at 60 to 85 degrees F and not more than 70 percent relative humidity for at least 48 hours prior to and during the installation of acoustic work, and until final acceptance.

Installation shall be per ASTM C 636, and as directed.

3.3 ITEMS EMBEDDED IN OTHER CONSTRUCTION

Placement locations and installation instructions shall be provided for items embedded in other construction.

3.4 ARRANGEMENT OF ACOUSTIC CEILINGS

Acoustic units shall be so arranged that units less than one-half width do not occur unless otherwise required to suit conditions.

Ceilings shall be so arranged that either the tile joint or the tile centerline centers on ceiling fixtures.

Acoustic units shall be so arranged that joints are parallel with room axis in both directions, and straight and in alignment with each other.

Runners shall be so arranged that the main runners are parallel with the room axis indicated, and in straight parallel alignment to each other.

3.5 PLACING SUSPENSION SYSTEM MEMBERS

Hanger wires shall be vertical and suspended from structural supporting members as follows:

Wires shall be secured to the bottom chord of joists or structural members by wire-tying or by metal clips especially designed for the purpose.

Direct-hung suspension system members shall be supported by hangers spaced not more than 6 inches from each end, and not more than 48 inches on center between end hangers. Members shall be kept 1/2 inch away from walls or partitions. Hangers shall be attached to the members to prevent vertical movement or rotation of the member. Members shall be installed level within 1/8 inch in 12 feet. Leveling shall be performed with the hanger wires taut to prevent subsequent downward movement of the members when the ceiling loads are imposed. Kinks or bends shall not be made in the hanger wires as a means of leveling the members.

Cross runners shall be installed at the required center distances within 1/32 inch. This tolerance shall be noncumulative beyond 12 feet. Intersecting cross runners shall form a 90-degree angle.

Abutting and intersecting runners shall be joined by approved methods. A joint connection shall provide the following alignment:

Exposed surfaces of two abutting main runners shall lie within a vertical distance of 1/64 inch of the same horizontal plane, and within a horizontal distance of 1/64 inch of the same vertical plane.

Exposed surfaces of two intersecting cross runners shall lie within a vertical distance of 1/64 inch of the same plane with the cross runner always above the main runner.

There shall be no visually apparent angular displacement of the longitudinal axis of one runner with respect to the other runner.

The horizontal gap between the exposed surfaces of abutting or intersecting members shall not exceed 0.020 inch.

Wall moldings shall be installed so that the extended leg of angle moldings, or the bottom flange of channel moldings, lies in the same horizontal plane as that of the runners resting on the molding. Wall molding at inside corners shall be cut and bent to conform to the corner and at outside corners shall be neatly butted. Corner caps shall be provided where the corners are constructed of bullnose masonry units. Moldings shall be fastened to wall at not more than 3 inches from each end, and not more than 16 inches on center between the end fastener holes. Fastening to wood plugs in masonry or concrete is not permitted.

3.6 SETTING MASONRY ANCHORAGE DEVICES

Masonry anchorage devices shall be set in masonry or concrete in accordance with the anchorage device manufacturer's printed instructions. Drilled holes shall be left rough, not reamed, and free from drill dust.

3.7 FRAMING OPENINGS FOR CEILING FIXTURES

Support members shall be provided at openings for ceiling fixtures or as indicated. Support members shall be of the size required to support the load without permitting deflection of the ceiling in excess of the performance requirements for the suspension system structural classification specified. Intermediate supports and separate hangers shall be provided if required.

3.8 ACOUSTIC LAY-IN-PANELS FOR EXPOSED-GRID CEILINGS

Exposed, direct-hung main runners shall be arranged as indicated and spaced not more than 48 inches on center.

Where recessed lighting fixtures are indicated, exposed main runners shall be located parallel with the long dimension and on both sides of each fixture.

Exposed cross runners shall be spaced nominally 24 inches on center.

When 24- by 24-inch lay-in panels are used, intermediate, exposed cross runners, 24 inches on center, shall be provided, installed parallel to the main runner, and intersecting the 48-inch long exposed cross runners at midpoint.

Moldings shall be installed at walls and other vertical surfaces, except where movable metal partitions having caps designed to receive suspension system members are indicated.

Lay-in panels shall be installed with edges resting on the flanges of the suspension system members and held in place with approved hold-down clips. Four holddown clips shall be provided for each acoustic lay-in panel. Clips shall be located approximately at the center of the sides and ends of each panel.

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SECTION 09670

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SECTION 09670

RESINOUS FLOORING

PART 1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 503R	(1993) Use of Epoxy Compounds with Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 307	(1994) Tensile Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings
ASTM C 413	(1996) Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings
ASTM C 531	(1995) Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings, Polymer Concretes
ASTM C 579	(1996) Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes
ASTM C 580	(1993) Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings
ASTM D 1308	(1987; R 1998) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 4060	(1995) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM E 162	(1998) Surface Flammability of Materials Using a Radiant Heat Energy Source

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

29 CFR 1910-SUBPART Z	Toxic and Hazardous Substances

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals", in sufficient detail to show full compliance with the

specification:

SD-06 Instructions

Application -Submit complete instructions for application of flooring system including any precautions or special handling instructions required to comply with OSHA 29 CFR 1910-SUBPART Z.

SD-14 Samples

Flooring - Submit cured samples of each floor finish or color combination.

1.3 DELIVERY AND STORAGE

Deliver the materials to the project site in unopened bags and containers clearly labeled with the name of the manufacturer, type of material, batch number, and date of manufacture. Store materials, other than aggregates, away from fire, sparks, or smoking areas. Maintain the storage area between 50 and 90 degrees F.

1.4 ENVIRONMENTAL CONDITIONS

Maintain the ambient room and floor temperatures at 65 degrees F, or above, for a period extending from 48 hours before installation until one week after installation. Concrete to receive surfacing shall have cured for at least 28 days and shall have been free of water for at least 7 days.

1.5 PROTECTION

Protect adjacent surfaces not scheduled to receive the flooring by masking, or by other means, to maintain these surfaces free of the flooring material.

1.6 QUALIFICATIONS OF INSTALLER

Installation shall be performed by an applicator approved by the manufacturer of the floor surfacing materials. The Contractor shall furnish a written statement from the manufacturer that the installer is acceptable.

PART 2 PRODUCTS

2.1 MATERIALS

Materials (except aggregate) used in the flooring shall be the products of a single manufacturer. Materials shall meet the following requirements:

2.1.1 Primer

Type recommended by the manufacturer to penetrate into the pores of the substrate and bond with the floor surfacing matrix to form a permanent monolithic bond between substrate and surfacing matrix.

2.1.2 Aggregate

Silica sand, quartz, granite, or other suitable chemical resistant material having a Mohr's hardness of not less than 6.0.

2.1.3 Binder

Thermo-setting epoxy.

2.1.4 Fillers

Inert mineral or cellulosic material as recommended by the manufacturer for use with the binder.

2.1.5 Top Coating

Color coating of type recommended by the manufacturer and selected from manufacturer's sample chart.

2.1.6 Physical Properties

The complete system after curing shall have the following properties when tested in accordance with the test methods listed for each property.

2.1.6.1 Epoxy Matrix Floor Surfacing

a. Compressive Strength: ASTM C 579; 10,000 psiminimum at 7 days.

b. Tensile Strength: ASTM C 307; 600 psi minimum at 7 days.

c. Flexural Modulus of Elasticity: ASTM C 580; 250,000 psi minimum at 7 days.

d. Thermal Coefficient of Expansion: ASTM C 531; 0.00004 inches per inch per degree F maximum.

e. Shrinkage: ASTM C 531; 0.5 percent maximum.

f. Bond Strength: ACI 503R, 300 psi minimum with 100 percent concrete failure (2500 psi Compressive Strength Concrete).

g. Flame Spread Index: ASTM E 162; 25 maximum.

h. Smoke Deposited: ASTM E 162; 4 mg maximum.

i. Abrasion Resistance: ASTM D 4060; 15 mg maximum weight loss.

j. Moisture Absorption: ASTM C 413; 1.0 percent maximum.

k. Chemical Resistance: ASTM D 1308; no effect when exposed to the following reagents for 7 days:

Acetic acid: 5 percent solution
Ammonium Hydroxide: 10 percent solution
Citric Acid: 5 percent solution
Coffee
Cola Syrup
Isopropyl Alcohol
Mineral Oil
Sodium Hydroxide: 5 percent solution
Tri-Sodium Phosphate: 5 percent solution
Urea: 6.6 percent solution

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Completely remove existing resilient flooring and adhesive by scraping. Remove all dirt, dust, debris, and other loose particles by sweeping or vacuum cleaning.

3.1.1 Concrete Surfaces

3.1.1.1 Mechanical Cleaning

Completely remove dirt, wax, paint, and laitance, by grinding with a terrazzo machine, sanding with coarse open grid sandpaper, sand blasting, chipping, bush hammering, or wire brushing.

3.1.1.2 Steam Cleaning

Completely remove all animal fats, grease, oil, and wax, using a high pressure steam cleaner equipped with a soap injection system. Scrape the surface to remove any build-up of debris. Then thoroughly saturate the surface with hot caustic solution. Allow the solution to remain on the floor for 15 to 20 minutes. Apply steam, with caustic, over the presoaked area until all contamination is removed. Leach the caustic residue from the surface using one or more applications of steam without caustic. Flush the floor with warm water.

3.1.1.3 Paint Stripping

Brush or spray on a paint stripping material that has been demonstrated to effectively remove the paint. Leave the stripping material on the surface until the paint has softened or blistered. Remove paint by scraping, brushing, or wiping. Rinse the surface in accordance with the stripping material manufacturer's recommendations. Avoid strippers containing toxic methylene chloride.

3.1.1.4 Acid Etching

Apply a 10 percent solution of muriatic acid at a rate of one quart per each 10 square feet of concrete surface. Allow the solution to stand until it stops bubbling but not less than 5 minutes. Remove the acid and wash the surfaces several times, as required, to remove all traces of the acid. Always dilute acid by pouring into water. Use face shield rubber gloves, and other safety equipment when using acids, alkalies, or solvents.

3.1.1.5 Air Drying

After cleaning, allow concrete surface to air dry thoroughly prior to application of surfacing. Blowers or oil free compressed air may be used. Do not use flame-drying methods. Prior to application of surfacing, test concrete surface for excessive moisture in at least two locations. Place rubber mats at each location with smooth side against concrete and place weight on top of mat to hold in position and ensure contact with concrete. Polyethylene with all edges taped may be used in lieu of mats. After 8 hours remove mat or sheeting and examine floor surface for moisture accumulation. If tests indicate accumulation of moisture at either location, additional air drying shall be undertaken until additional tests show no moisture accumulation.

3.1.2 Filling Cracks, Spalls, Joints, and Other Depressions

Fill all cracks, joints, spalls, and other depressions in the substrate with a latex underlayment, as recommended by the manufacturer compatible with the floor surfacing material.

3.2 MIXING

Proportion and mix the floor surfacing components in accordance with the manufacturer's instructions.

3.3 APPLICATION

Apply primer, floor surfacing, and seal coat in accordance with the manufacturer's recommendations and the following requirements.

3.3.1 Primer

Apply primer uniformly over the entire area to receive floor surfacing using clean rubber squeegees or clean steel trowels. Do not allow primer to collect in depressions. Allow primer to dry thoroughly before the next coat is applied. Reprime porous areas or areas where primer has dried.

3.3.2 Floor Surfacing

Apply mixed surfacing material to provide a finish floor surfacing not less than 3/16 inch thick. The entire surfacing in any one room or area shall be placed in one continuous operation without use of cold joints or divider strips. All surfaces shall be flush, true to plane and line, and level within 1/4 inch in 10 feet.

3.3.3 Seal Coat

Apply seal coat uniformly covering all surfaces after floor surfacing has cured and as recommended by the supplier.

3.4 PROTECTION

Surfacing shall set for a minimum period of 48 hours before traffic is allowed on the floor. Finished flooring shall be protected from traffic by covering with 30 pound building paper or other equally effective means until final acceptance of the project.

-- End of Section --

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SECTION 09920

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SECTION 09920

ARCHITECTURAL PAINTING

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items. Data shall include detailed analysis of each coating material required, with constituents measured as percentages of the total weight of coating.

Inhibitive Metal Primer
Pigmented Sealer
Latex Block Filler
Alkali Resistant Primer
Enamel Undercoat
Acrylic Latex
Acrylic Epoxy

SD-14 Samples

Manufacturer's Standard Color Charts shall be submitted showing manufacturer's recommended finish colors. Three color chips of each color and gloss scheduled shall also be submitted.

1.2 CONTRACTOR PERSONNEL QUALIFICATION

Personnel assigned to the work shall be certified by the Contractor to have had adequate previous experience in the successful application of paints and coatings similar to those specified.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered in their original, unbroken containers bearing the manufacturer's name and product identification. Containers breached by rough handling shall be removed from the site, together with their contents.

Paint materials, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to excessive heat, sparks, flame, or direct sunlight. Water-based materials shall be protected against freezing.

PART 2 PRODUCTS

2.1 MANUFACTURER'S AND MATERIALS

The following are suggested paint manufacturers and their products. Other

paint manufacturers' products of equal quality will be considered when submitted and approved by the Contracting Officer.

COATING	PITTSBURGH	SHERWIN WILLIAMS	GLIDDEN
Inhibitive metal primer	6-712	B50W1	6970
Pigmented sealer	6-2	B28W200	5111
Latex block filler	6-7	B25W25	5317
Acrylic latex, flat	72 line	A6 SERIES	6500
Acrylic latex, gloss	78 line	A8 SERIES	6600

PART 3 EXECUTION

3.1 GENERAL

Manufacturer's recommendations for surface preparation, thinning, mixing, handling, and application shall be considered a part of this specification.

3.2 PROTECTION OF FACILITIES

Contractor shall remove and reinstall or provide acceptable protection for hardware, accessories, lighting and electrical components, factory-finished materials, plumbing fixtures and fittings, and any other materials that may become splattered or damaged by the painting work.

3.3 SURFACE PREPARATION

3.3.1 General Requirements

Surfaces shall be clean, dry, and free from contaminants and foreign matter. Mildew and chalking shall be removed and the surface thoroughly sterilized. Chipped, peeling, or blistered paint shall be removed and the surface spot primed. Hard glossy surfaces shall be dulled and roughened to ensure proper adhesion.

3.3.2 Ferrous Metal

Surfaces shall be free from dirt, oil, grease, wax, and other contaminants. Heavy rust and loose mill scale shall be removed by hand, power tool, or blast cleaning.

3.3.3 Galvanized Steel

Surfaces shall be cleaned of all contaminants using a solvent such as lacquer thinner or xylol.

After cleaning, the surface shall be etched with a phosporic acid pre-treatment solution.

3.3.4 Aluminum

Surfaces shall be clean, dry, and free from oil and grease. Minor oxide film and corrosion shall be removed by hand or power tool cleaning.

3.3.5 Masonry

Surfaces shall be free from dirt, oil, grease, wax, form-release compounds, laitance, and other contaminants. Large cracks, voids, and other major surface imperfections shall be filled with mortar.

3.4 MIXING AND APPLICATION

3.4.1 General Procedures

No exterior painting shall be allowed in rainy weather or when rain is imminent. No paints or coatings shall be applied when the temperature or humidity is outside the limits recommended by the manufacturer.

Paints and coatings shall be applied by brush, roller, or airless spray.

Each coat of material applied shall be free from runs, sags, bubbles, foreign contaminants, variations in color, gloss, and texture, dry overspray, brush and roller marks, holidays (missed areas), or other evidence of poor application.

Paints and coatings shall be thoroughly worked into corners and crevices.

Newly painted surfaces shall be adequately protected from damage.

3.4.2 Procedures

There shall be at least 3 coats of paint applied in accordance with the manufacturer's instructions.

Coatings shall be applied as follows:

Material shall be thoroughly stirred to produce a uniform mixture.

Material shall be thinned for workability and improved spray characteristics, but only according to the manufacturer's instructions.

Each coat shall be applied uniformly at the minimum wet-film thickness specified by the manufacturer.

Special attention shall be given when coating sharp edges, corners, and crevices to ensure complete coverage.

Finish coats shall show good hiding characteristics and uniform appearance.

3.5 ACCEPTANCE PROVISIONS

3.5.1 Inspection

Contractor shall provide qualified personnel for inspection of his work to ensure that the requirements of this section have been fulfilled.

3.5.2 Correction

Spot-painting to correct damaged surfaces will be allowed only when touchup area blends into the surrounding finish. Otherwise, the entire area shall be recoated. Touchup shall be accomplished using the same method of application as was used to apply the original material.

3.6 PROTECTION

"WET PAINT" signs shall be posted to indicate newly painted surfaces.

3.7 PAINT SCHEDULE

SURFACE	PRIMER	UNDERCOAT AND FINISH COAT	FINISH COLOR AND SHEEN
Interior metal	Inhibitive metal primer	Acrylic Latex	Off-white Semi-gloss
Interior masonry (rough/porous)	Latex block filler	Acrylic Latex	Off-white Semi-gloss
Interior masonry (smooth)	Pigmented sealer	Acrylic Latex	Off-white Semi-gloss

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SECTION 10275

ELEVATED FLOOR SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM F 1066	(1995; Rev A) Standard Specification for Vinyl Composition Floor Tile

FEDERAL SPECIFICATIONS (FS)

FS TT-C-490	(Rev C; Am 2) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings

MILITARY SPECIFICATIONS (MS)

MS MIL-C-22750	(Rev F) Coating, Epoxy, High Solids
MS MIL-P-23377	(Rev G) Primer Coatings: Epoxy, High Solids

1.2 SYSTEM DESIGN

Elevated floor system shall consist of structural panels mounted on a grid system with adjustable pedestals to provide an underfloor space for accommodating electrical wiring and mechanical service lines.

Elevated floor system shall include a supporting grid in those areas shown to accommodate special equipment installation. Lateral bracing of grid areas and equipment supports shall be provided.

1.3 PERFORMANCE REQUIREMENTS

The Contractor warrants that, upon notification by the Government, the Contractor will immediately replace defective work with new work at no additional cost to the Government.

1.3.1 Elevated Floor Panels

Elevated floor panels shall be capable of supporting a uniform live load of a minimum 250 pounds per square foot with a deflection not to exceed 0.040 inch. Floor shall also be capable of supporting a minimum 1,000-pound load concentrated on 1 square inch at any point on the panel area without deflecting more than 0.080 inch with a safety factor of not less than 3, based on yield strength of the material being used. Floor system shall be laterally stable in all directions whether panels are in place or not. Finished assembly shall be rigid and free of vibration and rocking panels.

1.3.2 Pedestals

Each pedestal, with components as assembled for the specified heights, shall be capable of carrying a 5,000-pound axial load without permanent deformation.

1.3.3 Bonding Strength of Pedestal Adhesive

Adhesive for anchoring pedestal bases shall have a bonding strength capable of resisting an overturning moment of 1,000 inch-pounds when a force is applied to the top of the pedestal in any direction.

1.3.4 Stringers

Stringers shall provide seating for panels to preclude tilting, rocking, or vibrating when a live load is applied. Stringers shall be provided that can be added or removed after floor is in place. Each stringer shall support at least 650 pounds at mid-span without failure when tested. The yield strength of the material being used shall be at least 250 pounds at mid-span without failure when tested.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Floor Panels
Die-Formed Steel Panels
Diecast Aluminum Panels
Finish Flooring
Cutouts
Stringers
Edge Strips
Pedestals

SD-04 Drawings

Fabrication Drawings shall be submitted for Elevated Floor Systems consisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for Elevated Floor Systems in accordance with the paragraph entitled, "Installation," of this section.

Location Drawings shall show location of pedestals, cutouts, and the panel installation pattern.

Detail Drawings shall show details of the pedestals, pedestal-floor interlocks, floor panels, panel edging, floor openings, floor opening edging, floor registers, floor grilles, cable cutout treatment, perimeter base, expansion joints, and

peripheral support facilities.

SD-14 Samples

One complete Floor Panel.

One sample of the specified Finished Flooring.

1.5 DELIVERY, HANDLING, AND STORAGE

Materials shall be protected from weather, soil, and damage during delivery, storage, and construction.

Materials shall be delivered in the original unopened packages, containers, or bundles bearing the brand name and the name of the material.

1.6 FIELD MEASUREMENTS

Field measurements shall be taken prior to the preparation of shop drawings and fabrication to ensure proper fits.

1.7 PEDESTAL LOAD TEST

A static axial load of 5,000 pounds shall be imposed on the pedestals. Should there be failure of any component of any pedestal, the remaining pedestals shall be so tested, and pedestals that have a component failure shall be replaced with pedestals that have withstood the 5,000-pound axial load test.

1.8 ELECTRICAL RESISTANCE

Electrical resistance between an individual stringer and pedestal shall be less than 100 microhms. Range of electrical resistance of the floor covering to ground shall be 0.5 to 20,000 megohms for humidity from 40 to 60 percent relative humidity. A signal reference grid shall be provided as an equipotential surface for high frequency, low digital signals.

PART 2 PRODUCTS

2.1 FLOOR SYSTEM

Design and workmanship shall be such that the floor, as installed, shall be completely planar within plus or minus 0.060 inch in 10 feet, 0.100 inch for the entire floor, and 0.030 inch across panel joints.

Floor-panel joint-width tolerances shall be 0.008 inch as measured with a feeler gage at any point in any joint when the panels are in the pressure contact required in final installation.

System assembly shall be based upon an interference fit of connections.

2.2 PANELS

Panel design shall provide for convenient panel removal for underfloor servicing and for openings for new equipment. Design shall also provide necessary panel support where required openings entail cutting panels.

Floor panels shall be machined square to within plus or minus 0.005 inch with edge straightness plus or minus 0.0025 inch. Tolerances shall apply

to the panel before the plastic edging is applied.

2.2.1 Die-Formed Steel Panels

Floor panels shall be constructed of die-formed steel of physical properties and thickness to satisfy the load-bearing requirements of these specifications. A flat upper sheet, a die-formed lower sheet, and any auxiliary reinforcing shall be spot-welded into a rigid composite which shall withstand specified tests without failure of any weld. When the panels are to be grid-supported, panels shall be further tested by supporting them at two opposite edges and applying a 500-pound load at the center of a panel selected; the panel shall be similarly tested while supported at the other two edges. There shall be no weld failure at any point under this loading. This additional test shall be applied to one panel 500 square feet of floor in the system, but in no case less than two panels. When any weld fails, that number of panels designated by the Contracting Officer shall be similarly tested, and those that have a weld failure shall be replaced at no cost to the Government.

Before fabrication, steel used in constructing floor panels shall have been cleaned in accordance with FS TT-C-490 and given a Type I pretreatment. After fabrication, surfaces except those to receive floor covering shall be primed with 2 mils of epoxy polyamide conforming to MS MIL-P-23377 followed by a top coat of 2 mils of MS MIL-C-22750. Contractor shall provide 10 spare panels after installation of the entire floor system.

2.3 FINISH FLOORING

Panels shall be covered with vinyl reinforced tile flooring conforming to ASTM F 1066.

Floor covering shall be factory-attached to the floor by a noncreep conductive adhesive selected by the manufacturer.

Contractor shall provide two floor lifters and wall hangers for them.

2.4 CUTOUTS

Cable cutouts shall be finished with rigid polyvinylchloride or molded polypropylene edging to conform to the appearance level of the floor surface and to cover raw edges of the cutout panel. This extrusion shall be of a configuration to permit its effective and convenient use when new cable openings are required. At least 24 feet of additional extrusion shall be provided for future use.

Non-metallic adapter shall be provided for openings less than 4 inches wide.

Adapter shall be adhesively secured in cutout to preclude removal from panel. At least two adapters per 1000 square feet shall be provided for future use.

Opening larger than 4 inches wide shall use the rigid polyvinylchloride or molded polypropylene edging.

Cutting of panels, including cutouts, shall be performed outside of the building.

When size of cutout reduces the performance requirement of panel, the Contractor shall provide intermediate stringers adjacent to cutouts.

2.5 STRINGERS

Stringers shall be galvanized steel channel sections, having either conductive vinyl rib or a flat conductive vinyl gasket cemented on top surface of stringers to effect a complete air seal between the panels and the stringers and prevent slippage of floor panels horizontally.

Self-threading machine screws or clip nuts are not acceptable, but only unistrut-type bolts and nuts shall be used for connection. Method of mechanical fastening of stringer to pedestal shall not cause buckling of the stringer cross section. Bolted connection shall attach the bottom of the stringer to the pedestal. Provisions shall be made to allow equipment located on the floor to be bonded to the stringer.

2.6 EDGE STRIPS

An extruded rigid vinyl conductive edge strip less than 3 ohms shall be mechanically secured to the panel in a manner to preclude detachment under foot and wheel traffic after metal fabrication and machining have been completed. Top of the strip shall be flush with the top of the floor covering. Dimensional accuracy of the floor panel with the edge strip in place shall be such that, when installed, jointing shall be characterized by the interference fit of panel to panel.

2.7 PEDESTALS

Pedestals shall consist of a square steel base at least 4 by 4 inches that is designed to be attached to the subfloor with the manufacturer's recommended adhesive or by mechanical fasteners for the intended installation.

Vertical adjustment of pedestals shall be by threaded steel rod with a positively locking vibration proof elevating nut to control the height of the pedestal head.

Pedestal rods shall be cast-in with the base or welded to the base. Mechanical connections will not be permitted. All sliding surfaces in the elevating mechanism, such as threads, collars, sockets, and shafts, shall be machined to an interference fit. All welds shall be cleaned and a corrosion preventative coating applied.

Pedestal components, except rods and bearing pads, shall be diecast aluminum alloy or steel. Rods shall be rustproofed, after machining, by galvanizing in accordance with manufacturer's standards.

Pedestal cap shall be die form with suitable arrangements for fastening, floor stringers to pedestal cap, where the bolt and nut is installed from below the pedestal cap.

Pedestal design shall include devices for securely anchoring floor panels and supporting or stabilizing members of the system. Such devices shall be characterized by interference fits to preclude any metal-to-metal impact noises.

Any nonmetallic pads used on pedestal heads as bearing surfaces for floor panels shall be rigid conductive polyvinylchloride or vinyl.

Bolts, nuts, washers, and screws shall be cadmium-plated items.

At the periphery of the floor, full support shall be provided to the floor's extreme edge to ensure continuance of the specified strengths. Support system provided for this purpose shall not interfere with the free removal of affected panels.

2.8 ACCESSORIES

Ramps, steps, guardrails, perimeter fascia, plenum dividers, access grommets, underfloor service holes, core base and panel lifters shall be as shown. All accessories shall be provided by flooring manufacturer.

2.8.1 Ramp, Steps, and Landing

Provide necessary brackets, clamps, shoe assembly, threshold, fascia, closure plates and supporting stringers for complete installation.

Closure plates shall be 1/16 inch aluminum plate. Nose pieces shall be extruded aluminum.

Structural characteristics shall be equal to those specified under "Performance Requirements." Maximum slope shall be one in 12. Anchor closures securely to floor slab and to access floor system.

Surface of ramps shall be non-slip rubber.

2.8.2 Edge Closure

Provide 1/16 inch aluminum closure plate and extruded aluminum nosing at exposed edge of floor. Back up the closure plates with aluminum or steel framing braced diagonally, or anchor at bottom to continuous angle.

2.8.3 Guard Railing

Railing shall be double-rail standard railing of access floor manufacturer, made of extruded architectural aluminum members, and approved as to design and installation by Contracting Officer.

Railing posts shall be spaced at not more than 4 feet on center, shall be firmly anchored to the concrete floor slab and penetrate the access floor. Provide escutcheons where post penetrates floor surface.

Toprail shall be 42 inches above level of access floor surface. Midrail shall be midway between top rail and floor surface.

PART 3 EXECUTION

3.1 INSTALLATION

Layout for the installation shall keep to a minimum the number of cut panels at the floor's periphery.

Panel assembly shall be scribed into place at the periphery so that no voids result between the floor panels and the contiguous vertical surface trim. Pedestal position shall be accurately located, and any necessary changes in subfloor surfaces shall be made before other installation work is started.

Pedestal heads and stringers must be cleaned before assembly to assure the

proper electrical resistance between stringer and pedestals.

Before installation proceeds, the subfloor shall be cleared of dust and construction debris, including a final cleaning with high-suction industrial vacuum equipment. No cutting, trimming, or other debris-producing operation shall be conducted within the room where the floor is being installed. As the installation of floor panels proceeds, the area under the installed floor shall be vacuum cleaned as each row of panels is completed. Cleaning shall extend at least 4 feet back from the completed edge where possible.

Pedestals shall be installed with an epoxy adhesive recommended by the elevated-floor manufacturer. Installation shall provide a full bearing of the pedestal base on the subfloor. Where the contour of the floor does not permit this, the floor and the base shall be primed with adhesive, a grout made by filling adhesive with clean sand shall be applied over the primed floor area, and the pedestal base shall be firmly seated in the grout.

Installation shall be such that the entire floor is level within 0.10 inch.

After installation has been completed, the floor shall be vacuum cleaned and covered with a continuous sheet of paper or plastic of sufficient strength to withstand traffic which may be imposed upon the floor before the final acceptance. Should any break in this covering occur, the covering shall be immediately repaired or the entire covering shall be immediately replaced.

3.2 CLEANING

3.2.1 Surplus Material Removal

Surfaces of the work, and adjacent surfaces soiled as a result of the work, shall be cleaned. Equipment, surplus materials, and rubbish from the work shall be removed from the site.

3.2.2 Testing

Installed floor system shall be tested for required electrical resistance by the Contractor before acceptance by the Contracting Officer. Unacceptable and damaged portions of the elevated floor system shall be corrected, removed and replaced at no additional expense to the Government.

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SECTION 13852

FIRE-ALARM SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

1.2 GENERAL

The work includes:

Mounting a Government furnished fire alarm panel enclosure and providing raceways, outlet boxes, and wiring for the new fire alarm system as shown on the contract drawings.

The connection of the wiring from the devices to the control panels, the installation of the fire alarm devices, and the testing and commissioning of the fire alarm system are the responsibility of the Government.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the Fire Alarm Wiring.

SD-04 Drawings

As-Built Drawings - Raceways

PART 2 PRODUCTS

2.1 WIRING

Wiring shall have copper conductors and shall conform to NFPA 70.

Wiring from the fire alarm panel to the alarm devices, including, but not limited to bells and strobes, shall be two single conductor, No. 12 AWG, Type THHN or THWN. One conductor is to have black insulation and the other is to have red insulation.

Wiring from the fire alarm panel to the initiating devices (pull stations, flow switches, and detectors) and from the initiating devices to remote lamps shall be 4 conductor, No. 18 AWG, shielded with fireproof outer jacket and shall be installed in electrical metallic tubing. Wiring type

shall be as indicated on the contract drawings.

Wiring from the fire alarm control panels to the power sources shall be No. 12 AWG, Type THHN or Type THWN and shall be installed in electrical metallic tubing.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wiring

The Contractor shall install fire alarm control panel enclosure, device outlet boxes, raceways, and wiring as shown and described on the contract drawings.

The Contractor shall furnish and install a four inch square box (with raceway support hardware) that is mounted on the ceiling support structure with flexible conduit to a 4-inch octagonal box flush mounted in the suspended ceiling for future mounting of each detector. The detectors will be furnished and installed by the Government.

The Contractor shall furnish and install a four inch square box (with raceway mounting hardware and wiring) that is installed flush with the side of the walls for future mounting of each alarm bells and strobes assembly. The alarm bells and strobes will be furnished and installed by the Government.

The Contractor shall furnish and install a four inch square box (with raceway mounting hardware and wiring) that is installed flush with the side of the walls for future mounting of each pullstation. The pullstations will be furnished and installed by the Government.

The Contractor shall furnish and install raceway wiring to outlet boxes attached to the duct detectors (specified in Section 15972) tamper switches and flow switches (specified in Section 13930).

Wiring shall be continuous from outlet box to outlet box and from outlet box to the fire alarm panel enclosure with no splices. The Contractor shall leave two feet of spare wire coiled in each device outlet box. For each set of conductors in the fire alarm enclosure, the Contractor shall leave spare wire equal to the length of the enclosure plus two additional feet.

3.1.2 As-Built Drawings

The Contractor shall provide a "red-lined" copy of the fire alarm drawings showing the "as-built" raceway routing between outlet box and outlet box and between fire alarm control panel and outlet box. The Contractor shall provide a "red-lined" copy of the riser diagram showing the "as-built" sequence in which the outlet boxes for the field devices are connected to the fire alarm panel. These drawings shall be provided within 15 calendar days after the conduit and wiring have been installed.

3.1.3 Testing and Activation

The testing and activation of the fire alarm systems are the responsibility of the Government.

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SECTION 13930

FIRE SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M017	(1992) Manual of Steel Construction, Volume II, Connections

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A112.18.1M	(1996) Plumbing Fixture Fittings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126	(1995) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 135	(1997) Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1990) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 234/A 234M	(2000) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 53	(1999) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 563	(1997) Standard Specification for Carbon and Alloy Steel Nuts
ASTM B 370	(1998) Standard Specifications for Copper Sheet and Strip for Building Construction
ASTM C 592	(2000) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)

ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants
ASTM D 2000	(1999) Standard Classification System for Rubber Products in Automotive Applications

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.34	(1997) Valves - Flanged, Threaded and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions, Classes 150, 250, and 300
ASME B16.4	(1998) Cast-Iron Threaded Fittings Classes 125 and 250
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1998) Power Piping

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(1990; Supple I, II & III) Approval Guide

FEDERAL SPECIFICATIONS (FS)

FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

MILITARY STANDARDS (MIL-STD)

MIL-STD 101	(Rev B) Color Code For Pipelines and For Compressed Gas Cylinders

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(1994) Installation of Sprinkler Systems
NFPA 13E	(1989) Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems
NFPA 14	(1993) the Installation of Standpipe and Hose Systems

NFPA 1963	(1993) Screw Threads and Gaskets for Fire Hose Connections
NFPA 24	(1992) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	(2000) UL Standard for Safety - Rigid Metal Conduit

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section. Design and installation shall be in accordance with NFPA 13.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Design Analysis and Calculations shall be submitted for Automatic Sprinkler Systems including spray areas, hazard by class, and temperature setting of heads.

Manufacturer's Catalog Data shall be submitted for the following items in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Aboveground Piping and Fitting Materials
Valves
Sprinkler Heads
Miscellaneous Materials
Supporting Elements

Equipment and Performance Data shall be submitted for Fire Protection Sprinkler Systems consisting of information on use life, system functional flows, safety features, and mechanical automated details.

SD-04 Drawings

Connection Diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all controls, and internal tubing and wiring details.

Piping Materials
Supporting Elements
Alarm Systems
Sprinkler Heads
Valves

Schematics shall be submitted for Wet Pipe Sprinkler Systems indicating functional and physical interfaces with facilities and other systems.

SD-09 Reports

Test Reports shall be submitted for the following tests in accordance with the paragraph entitled, "System Testing," of this section.

Pressure Tests
System Operating Tests
Air Tests
Valve Operations Tests
Drainage Tests

PART 2 PRODUCTS

2.1 GENERAL

Fire-protection system materials and equipment provided under this section shall conform to the requirements of Underwriters Laboratories (UL) or the Factory Mutual (FM P7825) Approval Guide.

Products with UL label or seal or listing in UL 6, and products with FM label or listed in the FM P7825 Approval Guide are acceptable fire-protection system materials and equipment. Materials and equipment furnished shall be compatible with existing system.

2.2 ABOVEGROUND PIPING MATERIALS

2.2.1 Type BCS - Black Carbon Steel

Pipe (1/8 through 1-1/2 inches): Schedule 40 furnace butt weld black-carbon steel conforming to ASTM A 53, or ASTM A 135, Type F furnace butt welded; Schedule 10 conforming to ASTM A 135, Grade B

Pipe (2 through 8 inches, where indicated): Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53 or ASTM A 135, Type E (electric-resistance welded), Grade B, or Type S (seamless), Grade B; Schedule 10 conforming to ASTM A 135, Grade B

Unions (2 inches and under): 300-pound per square inch gage (psig) working steam pressure (wsp) female, screwed, black malleable iron, with ground joint and brass-to-iron seat conforming to ASME B16.39

Standard pipe couplings: Extra-heavy screwed black steel

Grooved pipe couplings (all sizes): 175-psig minimum working pressure with a housing fabricated in two or more parts of black malleable-iron castings. Coupling gasket shall be molded of synthetic rubber, conforming to requirements of ASTM D 2000. Coupling bolts shall be oval-neck, track-head type with heavy hexagonal nuts, conforming to ASTM A 183

Fittings (4 inches and under): 175-psig working pressure, cast iron, screwed, conforming to ASTM A 126, Class A, and ASME B16.4

Grooved fittings (all sizes): 175-psig working pressure fittings used with

grooved couplings shall be fabricated of black malleable-iron castings. If a manufacturer's standard-size malleable-iron fitting pattern is not available, fabricated fittings shall be used; fittings shall be fabricated from Grade B seamless-steel pipe and long-radius seamless welding fittings, with wall thickness to match pipe, conforming to ASTM A 234/A 234M and ASME B16.9.

2.3 SUPPORTING ELEMENTS

Piping system components and miscellaneous supporting elements shall be provided, including, but not limited to, building-structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical-pipe attachments; horizontal-pipe attachments; restraining anchors; and guides. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, natural, and other external forces.

Supporting elements shall be FM approved or UL listed and shall conform to ASME B31.1, MSS SP-58, and ASME B16.34.

2.3.1 Building-Structure Attachments

2.3.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to FS FF-S-325:

Group I:	Shield, expansion (lead, bolt, and stud anchors)
Group II:	Shield, expansion (bolt anchors), Type 2, Class 2, Style 1 or 2
Group III:	Shield, expansion (self drilling tubular expansion shell bolt anchors

Cast-in floor-mounted equipment-anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support mechanical-systems components.

2.3.1.2 Beam Clamps

Beam clamps shall be center-loading Types 21, 28, 29, and 30, UL listed, cataloged, and load-rated commercially manufactured products.

Type 20 beam clamps shall be used for pipe 2 inches and under.

Two Type 25 beam clamps shall be used per point of pipe support.

2.3.1.3 C-Clamps

C-clamps shall be used to support piping sizes 1-1/2 inches and smaller. C-clamps shall be FM approved and UL listed, with hardened cup-tip setscrew, locknut, and retaining strap. Retaining-strap section shall be not less than 1/8 by 1 inch. Beam-flange thickness to which clamps are attached shall not exceed 0.60 inch.

2.3.1.4 Inserts, Concrete

Concrete inserts shall be constructed in accordance with the requirements

of MSS SP-58 for Type 18 or 19 and ASME B16.34. When applied to piping in sizes 2-inch iron pipe size (ips) and larger, and where otherwise required by imposed loads, a 1-foot length of 1/2-inch reinforcing rod shall be inserted and wired through wing slots.

2.3.2 Horizontal-Pipe Attachments

2.3.2.1 Single Pipes

Piping in sizes up to and including 2-inch ips shall be supported by Type 1, 5, 6, 7, 9, 10, 11, or 12 solid, split-ring, or band type attachments.

Piping in sizes 2-1/2 inches and larger shall be supported by Type 1, 2, 3, or 4 attachments or with Type 41 or Type 49 pipe rolls.

2.3.2.2 Parallel Fire-Protection Pipes

Trapeze hangers and U-bolts fabricated from structural steel shapes, shall be used when so specified. Structural-steel shapes shall conform to supplementary steel requirements or the support shall be commercially available.

2.3.3 Vertical-Pipe Attachments

Single vertical-pipe attachments shall be Type 8.

2.3.4 Hanger Rods and Fixtures

Only circular solid cross section rod hangers shall be used to connect building structure attachments to pipe-support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature changes, pipe accessibility, and adjustment for load and pitch.

2.3.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with AISC M017.

2.4 FIRE-DEPARTMENT CONNECTIONS

Hose connections shall have National Firehose standard-thread form and rocker lugs in accordance with NFPA 1963. Hose-connection sizes and threads shall be compatible with the equipment used by the fire department serving the facility.

2.5 RISER ALARM EQUIPMENT

Water-flow alarm devices shall be UL or FM approved for fire-protection use.

2.6 SPRINKLER HEADS

2.6.1 Head Types

Standard 1/2-inch orifice sprinkler heads shall be used. Heads shall be

automatic on-off type. On-off type heads shall be installed only in wet-pipe systems.

Heads in finished areas below suspended ceilings shall be flush chrome-plated brass. Escutcheon plate shall be baked enamel finished to match ceiling.

Heads in unfinished areas below suspended ceilings shall be pendant type. Heads in all other locations shall be upright, pendant or sidewall type.

2.6.2 Temperature Rating

Fusible links shall be for ordinary hazard, except where otherwise indicated.

2.6.3 Spares

Spares shall be furnished for each type of sprinkler head, complete with appropriate storage cabinet and wrench.

2.6.4 Head Protection

Heads shall be protected with paper or plastic bags during painting operations. Protection shall be removed immediately upon finishing painting operations.

Head guards shall be provided wherever mechanical damage could occur. Guard finish shall be red enamel.

2.7 VALVES

2.7.1 Aboveground

Gate, globe, and check valves (all sizes) shall be FM approved or UL listed.

Ball valves, 2 inches and under, shall be FM approved, rated 300 psi, with provisions to wire or lock handle in place where critical alarm function may be isolated.

Butterfly valves, 6-, 8-, and 10-inch shall be FM approved, rated 175 psi, cast-iron bodied wafer type, with elastomer liners and seals. Liners shall act as gasket between standard piping-system flanges. Operator shall be worm-gear type, with permanently lubricated gears, and oiltight and watertight case, complete with handle and automatic position indication.

2.8 MISCELLANEOUS MATERIALS

2.8.1 Bolting

Flange and general-purpose bolting shall be hex-head and shall conform to ASTM A 307, Grade B. Heavy hex-nuts shall conform to ASTM A 563. Square-head bolts and nuts are not acceptable.

2.8.2 Elastomer Caulk

Polysulfide- or polyurethane-base elastomer-caulking material shall be two-component type, conforming to ASTM C 920.

2.8.3 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated, except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to ANSI A112.18.1M.

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing and one-piece or split-pattern type elsewhere. Escutcheons shall have provisions consisting of internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.8.4 Flashing

2.8.4.1 Copper

Sheet copper shall conform to ASTM B 370 and shall weigh not less than 16 ounces per square foot.

2.8.5 Flange Gaskets

Gaskets shall be suitable for the intended use and shall contain no asbestos.

2.8.6 Pipe-Thread Compounds

Tetrafluoroethylene tape or other suitable compounds shall be used.

2.9 FIRE-PROTECTION SYSTEM IDENTIFICATION

2.9.1 Service Labeling

Piping, including that concealed in accessible spaces, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels or tag designations shall be as follows:

SERVICE	LABEL OR TAG DESIGNATION
Main sprinkler supply	MAIN SPRINKLER SUPPLY
Sprinkler riser number	SPRINKLER RISER NO.
Sprinkler branch	SPRINKLER BRANCH
Standpipe piping	STANDPIPE

Piping shall be labeled and arrowed in accordance with the following:

Each point of entry and exit through walls

Each change in direction

In congested or hidden areas, at each point required to clarify service or indicate hazard

In long straight runs, labels shall be located at a distance visible to each other, but in no case shall the distance between labels exceed 40 feet.

Label lettering shall be 2 inches high. Where the size of pipes is 2-1/2-inch outside diameter and smaller, labels shall be attached to 16-gage aluminum sheet which shall be attached to the pipe with 12-gage galvanized wire. Labels shall be legible from the primary service and operating area.

Labels shall be made of self-sticking plastic film designed for permanent installation. Labels shall have red letters on white background.

Label and valve tag schedule above shall not be construed as defining or limiting the work. All piping systems shall be labeled.

2.10 PAINTING

Equipment of the manufacturer's standard product shall be furnished with the manufacturer's standard finish coat.

Other mechanical equipment shall be furnished with a shop-applied prime paint.

PART 3 EXECUTION

3.1 GENERAL

Installation of system materials and equipment shall be in accordance with the recommendations and provisions of NFPA 13, NFPA 13E, NFPA 14, and NFPA 24. Work shall be performed in the presence of the Contracting Officer who shall be notified by the Contractor 48 hours in advance of the start of work.

All installation work shall be performed by licensed fire protection sprinkler contractors, licensed for such work in the state where the work is to be performed.

3.2 UNDERGROUND PIPING INSTALLATION

3.2.1 Construction Tolerances for Types CIWP and DIWP

Maximum deviation from design elevation at any point along piping shall not exceed 2-1/2 inches for all sizes of piping.

Maximum deviation from line at the end of an 18-foot length of piping shall be 2-1/2 inches and cumulatively shall not exceed 6 inches. Corrections from line within preceding tolerances shall be made at a rate not to exceed 2-1/2 inches for any one length of piping.

Maximum deflection for curves for 18-foot lengths of cast ferrous pipe shall be in accordance with NFPA 24.

When the alignment requires deflections in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within established limits, as approved.

3.3 ABOVEGROUND PIPING-SYSTEMS INSTALLATION

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there will be not less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel shall be arranged to be in line with each other and parallel to the lines of the building.

Load rating for pipe-hanger supports shall be based on all lines filled with water. Deflection per span shall not exceed slope gradient of pipe. Schedule 40 and heavier ferrous pipe supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing. For concentrated loads such as valves, allowable span shall be reduced proportionately.

PIPE SIZE (INCHES)	ROD SIZE (INCHES)	HANGER SPACING FOR STEEL PIPE (FEET)
Up to 1	3/8	8
1-1/4	3/8	12
1-1/2	3/8	15
2-1/2 to 3-1/2	3/8	15
5	1/2	15
6	1/2	15
8	1/2	15

Vertical risers shall be supported at the base where possible and at intervals specified. Piping shall be guided for lateral stability as necessary. Clamps shall be placed under fittings wherever possible. Carbon-steel pipe shall be supported at each floor at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20-foot intervals for pipe 2-1/2 inches and larger.

Piping shall be securely supported with allowance for thrust forces and thermal expansion and contraction and shall not be subject to mechanical, chemical, vibrational, or other damage, in conformance with ASME B31.1.

3.4 SOUND STOPPING

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings; into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceiling where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

Sound stopping and vapor-barrier sealing of pipe shafts, and large floor

and wall openings may be accomplished by packing with properly supported mineral fiber insulation or by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Foam shall be finished with a rasp. Vapor barrier shall be not less than 1/8-inch thickness of vinyl mastic applied to visible and accessible surfaces. Where fire stopping is a consideration, only mineral fiber shall be used, and, in addition, openings shall be covered with 16-gage sheet metal.

3.5 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry or concrete walls, or floors.

Sleeves extending through floors, roofs, or load-bearing walls, and sleeves through fire barriers shall be continuous and fabricated from Schedule 40 steel pipe with welded anchor lugs. Other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve, and additionally shall provide a minimum 3/8-inch clearance. Sleeve shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and generation of noise.

Space between a pipe and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with mineral fiber conforming to ASTM C 592 wherever the piping passes through firewalls, equipment-room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction-surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction-surface penetration shall be filled with an elastomer calk to a depth of 1/2 inch. Surfaces to be calked shall be oil- and grease-free.

Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

3.6 ESCUTCHEONS

Escutcheons shall be provided at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. Escutcheons shall be chrome plated in occupied spaces and shall conceal openings in building construction. Escutcheons shall be firmly attached.

3.7 FLASHINGS

Flashings at systems penetrations of building boundaries shall be provided as indicated on drawings.

3.8 BRANCH-LINE TESTERS

Branch-line testers shall permit testing and flushing lines without shutdown of system or loss of fire-protection capability. Line testers shall be fitted with chain-attached caps.

Line testers shall be installed where indicated and on most remote branch lines being served by cross mains, so that testing may be accomplished at the dead corners of each sprinkler system.

3.9 PAINTING

Manufacturer's standard-finish equipment surfaces damaged during construction shall be brought to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replaced with new undamaged equipment at no additional cost to the Government.

Pipe hangers, supports, and other iron work in concealed spaces shall be thoroughly cleaned and painted with one coat of primer paint.

All firex piping, valves, and appurtenances, shall receive two coats of enamel, color No. 11105 (red) in accordance with MIL-STD 101 and FED-STD 595.

3.10 ELECTRICAL WORK

Electrical work is specified in Division 16, "Electrical," except for control and fire alarm wiring which shall be provided under this section in accordance with NFPA 70. Rigid metal conduit or intermediate metal conduit shall be used, except that electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

Motors, controllers, contactors, and disconnects shall be furnished with their respective pieces of equipment.

3.11 SYSTEM TESTING

Prior to acceptance of the work, completed systems shall be tested in the presence of the Contracting Officer. Upon Contracting Officer's approval, the Contractor shall submit certificates of testing.

Tests shall be hydrostatic, unless otherwise specified. Only potable water shall be used for testing.

Full-flow operational tests shall be performed for standpipe systems.

Government will supply testing water at a location determined by the Contracting Officer, but the Contractor shall be responsible for approved disposal of contaminated water.

Contractor shall prepare and maintain test records of piping-system tests. Records shall show personnel responsibilities, dates, test-gage identification numbers, ambient and test-water temperatures, pressure ranges, rates of pressure drops, and leakage rates. Each test acceptance shall require the signature of the Contracting Officer.

3.11.1 Test Gages

Test gages, to be acceptable, shall have 4-1/2-inch dials or larger with accuracy of plus or minus 1/2 of 1 percent of full-scale range and dial graduations and pointer width compatible with readability to within one-half of the accuracy extremes. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting position at midpoint of the dial or within the middle third of the scale range. Certification of accuracy and correction table shall bear a

date within 90 days prior to the test, test gage number, and the project number.

3.11.2 Pneumatic Testing

Tests shall be pneumatic when freezing conditions may occur and upon prior approval by the Contracting Officer. Compressed air used for testing shall be oil-free.

Pneumatic testing shall include swabbing all joints under a test pressure of 5 psig with a standard high film strength soap solution and observing for bubbles.

Duration of the test will be determined by the Contracting Officer and will be for 2 hours, minimum, to 24 hours, maximum. Test may be terminated by direction of the Contracting Officer at any point during this period after it has been determined that the permissible leakage rate has not been exceeded.

3.11.3 Test and Acceptable Criteria

Aboveground systems shall be tested at 200 psi and the applied pressure shall be maintained without further addition of test media for not less than 2 hours. Maximum allowable pressure drop shall be 2 psi.

Duration of each leakage test shall be not less than 2 hours; during the test, the main shall be subjected to 200 psi pressure based on the elevation of the lowest section under test and corrected to the elevation of the test gage.

Leakage shall be defined as the quantity of water supplied into the laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

No piping installation will be accepted if the leakage in gallons per hour exceeds 0.00054 times the number of joints in the length of the pipe line tested times the nominal diameter of the pipe in inches times the square root of the average test pressure expressed as psig. Amount of leakage at the joints shall not exceed 2 quarts per 100 joints regardless of pipe diameter.

Backflow prevention into connected potable-water systems and system devices shall be tested for proper functioning under conditions normal to their application.

Dripping or weeping joints shall be repaired.

3.12 DISINFECTION

Water piping, including valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Solution shall be held for a period of not less than 8 hours, at which time the solution shall contain a minimum residue of 2 ppm of available chlorine or the system shall be re-disinfected. After successful disinfection the piping shall be thoroughly flushed before placing into service. Water for disinfection, and flushing will be furnished by the Government.

3.13 CLEANING AND ADJUSTING

At the completion of the work, all parts of the installation shall be thoroughly cleaned. Equipment, pipes, valves, and fittings shall be cleaned of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system. Automatic control devices shall be adjusted for proper operation.

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SECTION 15003

GENERAL MECHANICAL PROVISIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(2000) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 766	(1986; R 1993) Standard Specification for Electrodeposited Coatings of Cadmium

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 82	(1996) Protection of Stratospheric Ozone

MILITARY SPECIFICATIONS (MS)

MS MIL-T-704	(Rev K) Treatment and Painting of Material

UNDERWRITERS LABORATORIES (UL)

UL 6	(2000) UL Standard for Safety - Rigid Metal Conduit
UL-02	(2001) Building Materials Directory

1.2 SUBMITTALS (Not Applicable)

1.3 COORDINATION

Contractor shall coordinate the work of the different trades so that interference between piping, equipment, structural, and electrical work will be avoided. All necessary offsets in piping and all fittings required to install the work properly shall be furnished complete in place at no additional cost to the Government.

1.4 MECHANICAL SYSTEMS IDENTIFICATION

1.4.1 Identification Tags

Identification tags made of brass or aluminum indicating function of a control or similar component shall be installed on such system devices. Tags shall be 2 inches in diameter and marking shall be stamped.

Equipment shall be provided with metal identification tags displaying an equipment designation number matching drawing or control diagram designation.

Tags shall be wired to valve or equipment items with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire.

1.4.2 Service Labeling

All piping, including that concealed in accessible spaces; exposed, bare and painted; and insulated, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels and valve tag schedule shall be in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Cold potable water	COLD POT. WATER
Rain water leader	RAIN WATER
Sanitary drain	SAN. DRAIN
Sanitary vent	SAN. VENT
Storm drain	STORM DRAIN
Air handling unit No. _____	AIR HAND. UNIT NO. _____
Automatic temperature control	AUTO. TEMP. CONTROL
Cooling tower water-supply	C TWR WATER-SUPPLY
Cooling tower water-return	C TWR WATER-RETURN
Steam	STEAM (__ PSI)
Steam condensate return	STEAM CONDEN RETURN
Condensate drain	COND. DRAIN
Compressed air supply	100 PSI SUPPLY AIR

Similar services with different temperatures or pressures shall be identified. Where pressures may exceed 125 pounds per square inch, gage, the maximum system pressure shall be included in the label.

Piping shall be labeled and arrowed in accordance with the following:

Each point of entry and exit of pipe passing through walls

Each change in direction, e.g., elbows, tees

In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

In long straight runs, labels shall be located at distances within eyesight of each other but in no case shall the distance between labels exceed 75 feet. All labels shall be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

Labels shall be made of self-sticking, plastic film designed for permanent installation.

1.5 COLOR CODING

Color coding of all piping systems shall be in accordance with ANSI A13.1.

1.6 APPROVAL REQUIREMENTS

Except as otherwise specified, approval of materials and equipment will be based on manufacturer's published data.

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL-02, and UL 6 will be acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, the Contractor may submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Methods of testing used by the specified agencies shall be outlined.

Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the American Society for Testing and Materials (ASTM), the American Society of Mechanical Engineers (ASME), or other standards, a manufacturer's certificate of compliance of each item will be acceptable as proof of compliance.

Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given rust-inhibiting treatment and standard finish by the manufacturer. Aluminum shall not be used in contact with earth, and where connected to dissimilar metal, shall be protected by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123 for exterior locations and cadmium-plated in conformance with ASTM B 766 for interior locations.

1.8 OZONE DEPLETING SUBSTANCES USED AS REFRIGERANTS

Releases of Ozone Depleting Substances (ODS) during repair, maintenance, servicing or disposal of appliances containing ODS's will be minimized by complying with all applicable sections of 40 CFR 82 Part 82 Subpart F. Any person conducting repair, maintenance, servicing or disposal of appliances owned by NASA comply with the following:

No Class I or Class II substances used as a refrigerant may be knowingly vented or otherwise released into the environment.

No appliances may be opened without meeting the requirements of 40 CFR 82 Part 82.156 Subpart F, regarding required practices regarding evacuation and collection of refrigerant, and 40 CFR 82 Part 82.158 Subpart F, regarding standards of recycling and recovery equipment.

No work may be conducted on appliances containing refrigerant except by persons who comply with 40 CFR 82 Part 82.161 Subpart F, regarding technician certification.

In addition, copies of all applicable certifications must be provided to the Contracting Officer at least 10 working days prior to initiating maintenance, repair, servicing, dismantling or disposal of appliances, including:

Proof of Technician Certification

Proof of Equipment Certification, if recovery or recycling equipment is to be provided by the Contractor

Proof of availability of certified recovery or recycling equipment, if equipment is to be provided by the Contractor

1.9 USE OF OZONE DEPLETING SUBSTANCES, OTHER THAN REFRIGERANTS

The use of Class I or Class II ODS's listed as nonessential in 40 CFR 82 Part 82.66 Subpart C is prohibited. These prohibited materials and uses include:

Any plastic party spray streamer or noise horn which is propelled by a chlorofluorocarbon

Any cleaning fluid for electronic and photographic equipment which contains a chlorofluorocarbon; including liquid packaging, solvent wipes, solvent sprays, and gas sprays

Any plastic flexible or packaging foam product which is manufactured with or contains a chlorofluorocarbon, including, open cell foam, open cell rigid polyurethane poured foam, closed cell extruded polystyrene sheet foam, closed cell polyethylene foam and closed cell polypropylene foam except for flexible or packaging foam

Any aerosol product or other pressurized dispenser which contains a chlorofluorocarbon, except for those listed in 40 CFR 82 Part 82.66 Subpart C.

A waiver may be requested should a programmatic of facility requirement dictate that a prohibited material is necessary to achieve project goals. A waiver request must be submitted in writing to the Contracting Officer.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, engraved laminated phenolic identification plates shall be provided for each piece

of mechanical equipment. Identification plates shall designate the function of the equipment. Designation shall be submitted with the shop drawings.

Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Identification plates shall be installed using a compatible adhesive.

2.2 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or on concrete slabs. Bolts shall be of the size and number recommended by the equipment manufacturer and shall be located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.3 SEISMIC ANCHORAGE

2.4 PAINTING

Equipment units shall be painted in accordance with MS MIL-T-704 or in accordance with equipment manufacturer's standards unless specified otherwise. Field retouching shall be accomplished only if approved; otherwise equipment shall be returned to the factory for refinishing.

PART 3 EXECUTION

3.1 INSTALLATION

Materials and equipment shall be installed in accordance with the requirements of the contract drawings and recommendations of the manufacturers. Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations.

3.2 EQUIPMENT PADS

Equipment pads shall be provided and shall be of dimensions shown or, if not shown, they shall conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports.

3.3 CUTTING AND PATCHING

Contractor shall install its work in such a manner and at such time as will require a minimum of cutting and patching of the building structure.

Holes in exposed locations, in or through existing floors, shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

Holes through masonry walls to accommodate sleeves shall be made with an iron pipe masonry core saw.

3.4 CLEANING

Exposed surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish painting or are enclosed within the building structure.

Before final acceptance, mechanical equipment, including piping, ducting, and fixtures, shall be clean and free from dirt, grease, and finger marks.

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SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S328	(1986) Specification for Structural Steel Buildings Load and Resistance Factor Design

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A112.18.1M	(1996) Plumbing Fixture Fittings
ANSI B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105/A 105M	(1998) Standard Specification for Forgings, Carbon Steel, for Piping Components
ASTM A 126	(1995) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 183	(1983; R 1990) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 234/A 234M	(2000) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 53	(1999) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 563	(1997) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 6/A 6M	(1995) Standard Specification for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use
ASTM B 32	(1995) Specification for Solder Metal

ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 88	(1999) Standard Specification for Seamless Copper Water Tube
ASTM C 109/C 109M	(1999) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 190	(1985) Standard Test Method for Tensile Strength of Hydraulic Cement Mortars
ASTM C 404	(1997) Standard Specification for Aggregates for Masonry Grouts
ASTM C 476	(1999) Standard Specification for Grout Masonry
ASTM C 67	(2000) Standard Test Methods of Sampling and Testing Brick and Structural Clay Tile
ASTM D 2000	(1999) Standard Classification System for Rubber Products in Automotive Applications

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.7	(1991) Hose Coupling Screw Threads (Inch)
ASME B16.11	(1996) Forged Steel Fittings, Socket-Welding and Threaded
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.25	(1997) Buttwelding Ends
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.4	(1998) Cast-Iron Threaded Fittings Classes 125 and 250
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.3	(1999) Process Piping
ASME B36.10M	(2000) Welded and Seamless Wrought Steel Pipe
ASME-17	(2000) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS-02	(1990) Welding Handbook; Eighth Ed; Vol

	Two - Welding Process

FEDERAL SPECIFICATIONS (FS)

FS HH-I-558	(Rev C) Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)
FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS WW-P-541/5	(Rev B; Am 1) Plumbing Fixtures (Sinks, Kitchen, Service, and Laundry Trays)

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Pipe and Fittings
Piping Specialties
Valves
Miscellaneous Materials
Supporting Elements

SD-04 Drawings

Fabrication Drawings shall be submitted for Pipes, Valves, and Specialities consisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for Pipes, Valves, and Specialties in accordance with the paragraph entitled, "Pipe Installation," of this section. Drawings shall include the

manufacturer's design and construction calculations, forces required to obtain rated axial, lateral, or angular movements, installation criteria, anchor and guide requirements for equipment, and equipment room layout and design. Drawing shall specifically advise on procedures to be followed and provisions required to protect expansion joints during specified hydrostatic testing operations.

As-Built Drawings shall be submitted for Pipes, Valves, and Accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

SD-07 Schedules

Material, Equipment, and Fixture Lists shall be submitted for Pipes, Valves, and Specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. A complete list of construction equipment to be used shall be provided.

SD-08 Statements

Listing of Product Installations for Piping Systems shall include identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. List shall include purchaser, address of installation, service organization, and date of installation.

SD-09 Reports

Test Reports on the following field tests shall be submitted for pipes, valves, and specialities.

Hydrostatic Tests
Air Tests
Valve-Operating Tests
Drainage Tests
Pneumatic Tests
System Operation Tests

SD-18 Records

Records of Existing Conditions shall be submitted consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

SD-19 Operation and Maintenance Manuals

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Test data shall be legible and of good quality.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Type BCS-125, (125-psi Service)

Pipe (1/8 through 1-1/2 inches) shall be Schedule 40 steam, Schedule 80 condensate, furnace butt weld, black carbon steel, conforming to ASTM A 53, Type F (furnace butt welded, continuous welded) and ASME B36.10M.

Pipe (2 through 10 inches) shall be Schedule 40 steam, Schedule 80 condensate, seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53 Type E, Grade B (electric-resistance welded) or Type S (seamless) and ASME B36.10M.

Fittings (2 inches and under) shall be 125-psig wsp, cast iron, screwed end, conforming to ASTM A 126 Class A and ASME B16.4.

Fittings (2-1/2 inches and over) shall be wall thickness to match pipe, long radius butt weld, black carbon steel, conforming to ASTM A 234/A 234M, Grade WPB and ASME B16.9.

Couplings (2 inches and under) shall be commercial standard weight for Schedule 40 pipe and commercial extra heavy weight for Schedule 80 pipe, black carbon steel where threaded, and 2,000-or 3,000-psi wog forged carbon steel, conforming to ASTM A 105/A 105M and ASME B16.11, where welded.

2.1.2 Type CPR, Copper

2.1.2.1 Copper Above Ground For 100 PSI Airline

Tubing (2 inches and under) shall be seamless copper tubing, conforming to Type K (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Fittings (2 inches and under) shall be 150-psig wsp wrought-copper solder joint fittings conforming to ASME B16.22.

Unions (2 inches and under) shall be 150-psig wsp wrought-copper solder joint, conforming to ASME B16.22.

Solder shall be 60-40 tin-antimony, alloy Sb-5, conforming to ASTM B 32.

2.1.2.2 Type K, Copper Under Ground

Piping shall be Type K seamless copper tube, conforming to ASTM B 88. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22. Fittings for connection to corporation cocks shall be cast bronze, flared-type, conforming to ASME B16.26. Joints shall be brazed.

2.1.2.3 Type CPR-INS, Copper Under Ground Insulated

Piping shall be insulated Type K seamless copper tube conforming to ASTM B 88. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22. Joints shall be brazed.

Insulation shall be not less than 2 inches thick, suitable for continuous service temperatures of not less than 250 degrees F. Insulation shall be factory-molded, closed-cell polyurethane foam of not less than 2.5 pounds per cubic foot density. Insulation shall be waterproofed with an extruded rigid Type II virgin polyvinylchloride, with minimum wall thickness of 60

mils through 4 inches outside diameter (od), 85 mils through 6.625 inches od, and 110 mils through 12.750 inches od. Fitting covers shall be fabricated from same materials and thickness as adjacent pipe cooling according to the manufacturer's directions.

2.1.3 Grooved Pipe Couplings and Fittings

Couplings shall have a housing, fabricated in two or more parts, of black, ungalvanized malleable iron castings. Coupling gasket shall be molded synthetic rubber, conforming to ASTM D 2000. Coupling bolts shall be oval-neck, track-head type, with hexagonal heavy nuts conforming to ASTM A 183.

All pipe fittings used with couplings shall be fabricated of black, ungalvanized malleable iron castings. Where a manufacturer's standard-size malleable iron fitting pattern is not available, approved fabricated fittings may be used.

Fittings shall be fabricated from Schedule 40 or 0.75-inch wall ASTM A 53, Grade B seamless steel pipe; long radius seamless welding fittings with wall thickness to match pipe, conforming to ASTM A 234/A 234M and ASME B16.9.

2.2 PIPING SPECIALTIES

2.2.1 Dielectric Connections

Dissimilar pipe metals shall be electrically insulated from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.2.2 Hose Faucets

Hose faucets shall be constructed with 1/2-inch male inlet threads, hexagon shoulder, and 3/4-inch hose connection, conforming to ANSI A112.18.1M. Hose-coupling screw threads shall conform to ASME B1.20.7.

Vandalproof, atmospheric-type vacuum breaker shall be provided on discharge.

2.2.3 Pressure Gages

Pressure gages shall conform to ANSI B40.1 and to requirements specified herein. Pressure gages shall be Type I, (for air, steam, and water) Class 1 (pressure). Pressure-gage size shall be 3-1/2 inches nominal diameter. Case shall be corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A 6/A 6M, with an ASM No. 4 standard commercial polish or better. Gages shall be equipped with adjustable red marking pointer and damper-screw adjustment in inlet connection. Service-pressure reading shall be at midpoint of gage range. All gages shall be equipped with gage isolators.

Steam gages shall be fitted with black steel syphons and steam service pressure-rated gage cocks or valves.

2.2.4 Line Strainers, Steam Service

Strainers shall be Y-type with removable strainer element.

Body end connections shall be flanged for all valves larger than 2 inches, unless butt weld ends are specified. Screwed weld shall be used for sizes

2 inches and under to suit specified piping system end connection and maintenance requirements.

Body working steam pressure rating shall be the same as the primary valve rating for system in which strainer is installed, except where welded end materials requirements result in higher pressure ratings. Body shall have integral cast or forged arrows to indicate direction of flow. Strainer bodies shall be provided with blowdown valves that have discharge end plugged with a solid metal plug. Closure assembly shall be made with tetrafluoroethylene tape. Bodies fitted with bolted-on screen retainers shall have offset blowdown holes.

Body materials shall be manufacturer's standard metallurgical equivalents for service pressures of 150-psi wsp and greater, and for lower pressure ratings where welding is required.

Minimum free-hole area of strainer element shall be equal to not less than 3.4 times the internal area of connecting piping. Strainer screens shall have perforations not to exceed 0.045-inch or equivalent wire mesh. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel and shall be fitted with backup screens where necessary to prevent collapse.

2.2.5 Float and Thermostatic Steam Traps

Steam traps shall be of the mechanical ball float type having cast iron bodies, National Pipe Thread (NPT) connections, and all stainless steel internals. Incorporated into the trap body shall be a stainless steel balanced pressure thermostatic air vent capable of withstanding 45 degrees F (25 degrees C) of superheat and resisting water hammer without sustaining damage. Internals of the trap shall be completely serviceable without disturbing the piping.

2.3 VALVES

2.3.1 Ball and Butterfly Valves

Ball valves shall conform to MSS SP-72. Valves shall be Style 1A and shall be rated for service at not less than 175 psig at 200 degrees F. Valve bodies in sizes 2 inches and smaller shall be screwed-end connection-type constructed of Class A copper alloy. Balls and stems of valves 2 inches and smaller shall be manufacturer's standard with hard chrome plating finish. Valves shall be suitable for flow from either direction and shall seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. All valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene.

2.3.2 Drain, Vent, and Gage Cocks

Drain, vent, and gage cocks shall be T-head, ground key type, with washer and screw, constructed of polished ASTM B 62 bronze, and rated 125-psi wsp. End connections shall be rated for specified service.

2.3.3 Gate Valves (GAV)

Gate valves 2 inches and smaller shall conform to MSS SP-72. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Packing shall be

made of non-asbestos type materials. Valves shall be rising stem type.

2.3.4 Globe and Angle Valves (GLV-ANV)

Globe and angle valves 2 inches and smaller, shall be 125-pound, 125-psi conforming to MSS SP-72 and to requirements specified herein. Disc shall be free to swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Packing shall be made of non-asbestos type materials. Disk and packing shall be suitable for pipe service installed.

2.3.5 Standard Check Valves (SCV)

Standard check valves in sizes 2 inches and smaller shall be 125-psi swing check conforming to MSS SP-72, except as otherwise specified. Swing-check pins shall be nonferrous and suitably hard for the service. Discs shall be composition type. Swing-check angle of closure shall be manufacturer's standard unless a specific angle is needed.

Check valves shall be provided with positive-closure devices and valve ends shall be mechanical joint.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Bolting

Flange and general purpose bolting shall be hex-head and shall conform to ASTM A 568, Class 4.8 or above (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A 563. Square-head bolts and nuts are not acceptable. Threads shall be coarse-thread series.

2.4.2 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to FS WW-P-541/5

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. All escutcheons shall have provisions consisting of setscrews for maintaining a fixed position against a surface.

2.4.3 Grout

Shrink-resistant grout shall be a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C 404 and ASTM C 476.

Shrink-resistant grout shall be a combination of premeasured and packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

Tensile strength	ASTM C 190	1,900 psi, minimum
Compressive strength	ASTM C 109/C 109M	14,000 psi, minimum
Shrinkage, linear maximum		0.00012 inch per inch,

Water absorption	ASTM C 67	0.1 percent, maximum
Bond strength to steel in shear minimum		1,000 psi, minimum

2.4.4 Pipe Thread Compounds

Tetrafluoroethylene tape not less than 2 to 3 mils thick shall be used in potable and process water and in chemical systems for pipe sizes to and including 1-inch ips (iron pipe size). Tetrafluoroethylene dispersions and other suitable compounds may be used for all other applications upon approval; however, no lead-containing compounds may be used in potable water systems.

2.5 SUPPORTING ELEMENTS

All necessary piping systems and equipment supporting elements shall be provided, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. All supporting elements shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Supporting elements shall conform to requirements of ASME B31.3, FS FF-S-325, MSS SP-58, and MSS SP-69 except as noted.

Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Supporting elements exposed to weather shall be hot-dip galvanized. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

Type designations specified herein are based on MSS SP-58 and MSS SP-69. Masonry anchor group-, type-, and style-combination designations shall be in accordance with FS FF-S-325. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

2.5.1 Building Structure Attachments

2.5.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to FS FF-S-325 for the following types:

Group I - shield, expansion (lead, bolt and stud anchors)

Group II - shield, expansion (bolt anchors)

Type 2 - machine bolt expansion shield anchors

Class 2 - open-end expansion shield anchors

Style 1 - single-end expansion shield anchors

Style 2 - double-end expansion shield anchors

Group III - shield, expansion (self-drilling

tubular expansion shell bolt anchors)

Group VIII - anchors, expansion (nondrilling)

Powder-actuated anchoring devices shall not be used to support any mechanical systems components.

2.5.1.2 Beam Clamps

Beam clamps shall be center-loading Type 21.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, Type 20, 25, 27 may be used for piping sizes 2 inches and less and for piping sizes 2 through 10 inches, provided two counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, rod diameter shall be determined in accordance with referenced standards.

2.5.1.3 C-Clamps

C-clamps may be used to support piping sizes 1 inch and smaller. C-clamps shall be FM approved and UL listed with hardened cup-tip setscrew, locknut, and retaining strap. Retaining strap section shall be not less than 1/8 by 1 inch. Beam flange thickness to which clamps are attached shall not exceed 0.60 inch.

2.5.2 Horizontal Pipe Attachments

2.5.2.1 Single Pipes

Type 1 assemblies shall be used on insulated piping and shall have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

Steam piping shall be supported with Type 43 pipe rolls.

Type 40 shields shall be used on all insulated piping. Area of the supporting surface shall be such that compression deformation of insulated surfaces does not occur. Longitudinal and transverse shield edges shall be rolled away from the insulation.

2.5.2.2 Parallel Pipes

Trapeze hangers and U-bolts fabricated from structural steel shapes, approved by the Contracting Officer, shall be used in congested areas and where multiple pipe runs occur. Structural steel shapes shall be commercially available.

2.5.3 Vertical Pipe Attachments

Vertical pipe attachments shall be Type 8.

Shop drawing data shall include complete fabrication and attachment details of any spring supports.

2.5.4 Hanger Rods and Fixtures

Only circular cross section rod hangers may be used to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers only when and where approved by the Contracting Officer.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.5.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with AISC S328.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Piping systems shall be fabricated and installed in accordance with ASME B31.1, MSS SP-69, and AWS-02.

Connections between steel piping and copper piping shall be electrically isolated from each other with dielectric couplings (or unions) or flanged with gaskets rated for the service.

Final connections to equipment shall be made with unions or flanges provided every 100 feet of straight run. Unions shall be provided in the line downstream of screwed- and welded-end valves.

All pipe ends shall be reamed before joint connections are made.

Screwed joints shall be made up with specified joint compound and not more than three threads shall show after joint is made up.

Joint compounds shall be applied to the male thread only and care shall be exercised to prevent compound from reaching the unthreaded interior of the pipe.

Screwed unions, welded unions, or bolted flanges shall be provided wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Piping systems shall be securely supported with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in ASME B31.1.

Field welded joints shall conform to the requirements of the AWS-02, ASME B31.1, and ASME-17.

Piping systems butt weld joints may be made with backing rings. Backing ring materials shall be compatible with materials being joined. Joint configuration shall conform to ASME B16.25.

3.2 VALVES

Valves shall be provided in piping mains and all branches and at equipment where indicated and as specified.

Valves shall be provided to permit isolation of branch piping and each equipment item from the balance of the system.

Riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger shall be provided. Shutoff valve body shall be tapped and fitted with a 1/2-inch plugged globe valve.

Valves unavoidably located in furred or other normally inaccessible places shall be provided with adequately sized access panels approved by the Contracting Officer for the location.

3.3 SUPPORTING ELEMENTS INSTALLATION

Supporting elements shall be provided in accordance with the referenced codes and standards.

Piping shall be supported from building structure. No piping shall be supported from roof deck or from other pipe.

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there shall be no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

Piping support elements shall be installed at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Load rating for all pipe-hanger supports shall be based on insulated weight of lines filled with water and forces imposed. Deflection per span shall not exceed slope gradient of pipe. Supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, the allowable span shall be reduced proportionately:

PIPE SIZE INCHES	ROD SIZE INCHES	STEEL PIPE FEET	COPPER PIPE FEET
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8
2	3/8	12	10
2-1/2 to 3-1/2	1/2	12	12

Vibration isolation supports shall be provided where needed.

Vertical risers shall be supported independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Risers

shall be guided for lateral stability. For risers subject to expansion, only one rigid support shall be provided at a point approximately one-third down from the top. Clamps shall be placed under fittings unless otherwise specified. Carbon-steel pipe shall be supported at each floor and at not more than 15-foot intervals for pipe 2 inches and smaller and at not more than 20-footintervals for pipe 2-1/2 inches and larger.

3.4 PENETRATIONS

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces shall include space above ceilings where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

Sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings shall be accomplished by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 120 degrees F, by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Foam shall be finished with a rasp. Vapor barrier shall be not less than 1/8-inch thick vinyl coating applied to visible and accessible surfaces. Where high temperatures and fire stopping are a consideration, only mineral wool shall be used and openings shall also be covered with 16-gage sheet metal.

3.5 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry, concrete walls and floors.

Sleeves passing through steel decks shall be continuously welded or brazed to the deck.

Sleeves that extend through floors, roofs, load bearing walls, and fire barriers shall be continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. All other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve and shall provide a minimum 3/8-inch clearance. Sleeve size shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and the generation of noise.

Space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with a mineral fiber conforming to FS HH-I-558, Form B, Type 1 (flexible blanket), Class 8, (451 to 1,000 degrees F). This packing shall be provided wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration shall be filled with an elastomer calk to a depth of 1/2 inch. All surfaces to be calked shall be oil- and grease-free.

Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

Sleeve height above roof surface shall be a minimum of 12 and a maximum of 18 inches.

3.6 ESCUTCHEONS

Escutcheons shall be provided at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. For insulated pipes, the plates shall be large enough to fit around the insulation. Escutcheons shall be chrome-plated in all occupied spaces and of size sufficient to effectively conceal openings in building construction. Escutcheons shall be firmly attached with setscrews.

3.7 FLASHINGS

Flashings shall be provided at penetrations of building boundaries by mechanical systems and related work.

3.8 DISINFECTION

Water piping, including all valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Solution shall be held for a period of not less than 8 hours, after which the solution shall contain not less than 10 ppm of available chlorine or the piping shall be redisinfected. After successful sterilization, the piping shall be thoroughly flushed before placing into service. Flushing shall be complete when the flush water contains less than 0.5 ppm of available chlorine. Water for disinfection will be furnished by the Government. Contractor shall be responsible for approved disposal of contaminated flush water.

Piping shall be flushed with potable water until visible grease, dirt and other contaminants are removed (visual inspection).

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SECTION 15055

MECHANICAL WELDING

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SECTION 15055

MECHANICAL WELDING

PART 1 GENERAL

1.1 SUMMARY

This specification contains the minimum requirements for qualifying welding procedures and welders for effecting and inspecting weld joints, in mechanical fabrications of carbon steel, low alloy steel, and austenitic stainless steel materials and any other metals used in pressure containing systems.

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1 (1998) Power Piping

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/AWS D1.1 (2000) Structural Welding Code - Steel

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-08 Statements

Within fifteen days after receipt of Notice to Proceed, the Contractor shall submit, for approval to the Contracting Officer, the following items:

Welding Procedure Specifications (WPS), two copies

Certified Procedure Qualification Records (PQR), two copies

Fifteen calendar days prior to any employee welding and/or brazing on project material, the Contractor shall submit, for approval, to the Contracting Officer, the following items:

Certified Welder Performance Qualifications (WPQ), two copies

1.4 QUALIFICATIONS

1.4.1 General

The Contractor shall qualify the welding procedures and welders/brazers by tests prescribed in the applicable code or specification, notwithstanding

the fact that the code or specification may allow pre-qualified procedures.

High pressure is defined herein as 125 psig and above. Low pressure is defined as below 125 psig.

1.4.2 High-Pressure Vessels, High-Pressure Piping and Ancillary Fabrication

The welding qualification documents WPS, PQR and WPQ shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Ancillary fabrication performed in conjunction with mechanical piping and pressure vessels shall be limited to pipe supports, brackets, and mounts related to the piping and/or vessel installation. The construction of steel building structures shall conform to the Structural Steel Welding Code.

1.4.3 Low-Pressure Piping

1.4.3.1 Plumbing

Plumbing work shall be performed by a state licensed plumber.

1.4.3.2 Low-Pressure Piping

The qualification documents, WPS, PQR and WPQ for low-pressure piping shall be in accordance with Section IX of the ASME BPV Code.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CONSTRUCTION

3.1.1 Piping

3.1.1.1 Low Pressure

A - Plumbing: The Contractor shall fabricate, assemble, weld/braze/solder in accordance with the BOCA Basic Plumbing Code requirements.

B - Other Low Pressure Piping: The Contractor shall fabricate, assemble, weld in accordance with the ASME B31.1, Power Piping Code requirements.

3.1.2 Ancillary Fabrication

Ancillary components shall be fabricated, assembled and welded in accordance with ANSI/AWS D1.1, Structural Steel Welding Code.

3.2 ENVIRONMENTAL AND HEAT CONTROLS

3.2.1 Preheat

3.2.1.1 Materials For Which No Preheat Is Required By Code

The Contractor shall not weld when rain or snow is falling on the surfaces of the parts in the area to be welded, or when they are wet from rain, snow or ice. When adverse conditions exist, the welder and work area shall be properly shielded and the material to be welded shall be above 50 degrees F When the material is below 50 degrees F and/or the thickness is in excess of one inch, the Contractor shall heat the joint to a temperature that is

warm to the hand, approximately 100 degrees F.

The Contractor shall preheat all joints displaying moisture until the moisture is evaporated.

3.2.1.2 Materials For Which Preheat Is Required By Code

The Contractor shall preheat the material to be welded to the temperature specified in the applicable code.

3.2.2 Interpass Temperature

Interpass temperature shall not fall below the preheat temperature. It may be monitored directly adjacent to the weld joint. Maximum interpass temperature shall not exceed the code-specified temperature limits.

3.2.3 Post Weld Heat Treatment

Weldments shall be heat treated as required by the applicable NASA approved, Code qualified/certified welding documentation, WPS and PQR.

3.3 INSPECTION/NONDESTRUCTIVE EXAMINATION (NDE)

3.3.1 General

The Contractor shall perform the necessary fabrication/erection inspection prior to assembly, during assembly, during welding and after welding, to ensure that materials and workmanship meet the minimum requirements of the contract documents.

The Contracting Officer will perform the final acceptance of all welded joints.

Prior to the Contracting Officer's inspection, the Contractor shall remove all slag, scale and spatter from all welds. The procedure employed shall not produce notches in either the weld metal or adjacent base metal.

The Contractor shall repair and reinspect all unacceptable welds at no additional cost to the Government.

After weld joints have been satisfactorily completed by the Contractor and accepted by the Contracting Officer, the Contractor shall clean the joint area to a bright, unpitted, and unscarred surface. The base metal and weld thicknesses shall not be reduced below applicable code allowable limits. The surface shall then be protected in accordance with the applicable contract documents specifying coatings or specific surface conditions.

3.3.2 Piping and Ancillary Fabrication

3.3.2.1 General

All Nondestructive Examination (NDE) shall be performed in accordance with the requirements of Section V of the ASME Boiler and Pressure Vessel Code, for all new and repaired piping, pressure vessels, and minor structural fabrication, except for branch connection and socket welds.

3.3.3 Piping

3.3.3.1 Low Pressure

A. Acceptance Requirements

(1) - Plumbing piping systems shall meet the acceptance requirements of the BOCA Basic Plumbing Code.

(2) - Other low pressure piping systems shall meet the acceptance requirements of the ASME B31.1, Power Piping Code.

3.3.4 Ancillary Fabrication

All ancillary component welds shall be visually inspected, as appropriate, in accordance with ASME Section V, Nondestructive Examination. All ancillary fabrication welds shall satisfy the acceptance criteria of applicable codes.

3.4 PROTECTION OF ADJACENT MATERIALS

The Contractor shall sufficiently protect machinery, materials, floor, and surfaces adjacent to the welding/brazing/soldering operations, to prevent any damage from these operations.

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DIVISION 15 - MECHANICAL

SECTION 15700

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SECTION 15700

HEATING / VENTILATION / AIR CONDITIONING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(1989; 5th Ed) National Standards for Testing and Balancing, Heating, Ventilating, and Air Conditioning Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(2000) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2000) Standard Specification for Structural Steel
ASTM A 527/A 527M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
ASTM C 1139	(1990) Standard Specification for Fibrous Glass Thermal Insulation and Sound Absorbing Blanket and Board for Military Application

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-06	(2000) Handbook, HVAC Systems and Equipment (IP Edition)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 220	(1992) Standard Types of Building Construction
NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-06	(1985; 1st Ed) HVAC Duct Construction Standards - Metal and Flexible
SMACNA-07	(1993) HVAC Systems - Testing, Adjusting and Balancing

UNDERWRITERS LABORATORIES (UL)

UL 181	(1996) UL Standards for Safety Factory-Made Air Ducts and Air Connectors

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Unit Heaters
Air-Conditioning Units
Filters

Manufacturer's Catalog Data shall be submitted for the following items in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Air Diffusers
Heat and Cooling Coils
Ductwork
Vibration Isolators
Insulation
Unit Heaters
Air-Conditioning Units
Filters
Spare Parts
Accessories

Equipment Foundation Data for the following items shall include equipment weight and operating loads; horizontal and vertical loads; starting torques and their direction; rpm of equipment; size, location and projection of anchor bolts; horizontal and vertical clearances for installation, operation, and maintenance; plan dimensions of foundations and relative elevations; and installation requirements such as noise abatement, vibration isolation, and utility services.

Vibration Isolators
Piping
Coils
Unit Heaters
Air-Conditioning Units
Ductwork
Air Diffusers

SD-04 Drawings

Control Diagrams shall be submitted for the following systems indicating the physical and functional relationship of equipment, electrical diagrams showing size, type and capacity of the systems, and pneumatic diagrams for air and gas systems.

Air Systems
Hydronic Systems
Unitary Systems

Fabrication Drawings shall be submitted for the following items:

Valves
Air Diffusers
Heat and Cooling Coils
Ductwork
Vibration Isolators
Unit Heaters
Air-Conditioning Units

Installation Drawings shall be submitted for the following systems in accordance with the paragraph entitled, "Installation," of this section. Drawings shall show details of equipment room layout and design.

Air Systems
Hydronic Systems
Unitary Systems

SD-06 Instructions

Manufacturer's Installation Instructions shall be submitted indicating the manufacturer's recommended method and sequence of installation for HVAC Systems.

Operating Instructions shall be submitted for all Proposed Equipment.

SD-07 Schedules

Material, Equipment, and Fixture Lists shall be submitted showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

SD-09 Reports

Test Reports shall be submitted for the following field tests on each type of HVAC system.

Pressure Tests
Operating Tests

SD-19 Operation and Maintenance Manuals

Contractor shall submit 6 copies of the Operation and Maintenance Manuals 30 days prior to testing the system involved. Data shall be updated and resubmitted for final approval no later than 30

days prior to contract completion.

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Test data shall be legible and of good quality.

Air Systems
Hydronic Systems
Unitary Systems

1.3 STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

Equipment and materials stored at the site shall be fully protected from damage, dirt, debris, and weather.

1.4 AUTOMATIC CONTROL OF SYSTEMS

Automatic control systems shall be complete in all details and shall include accessories to maintain specified conditions.

Automatic temperature control systems may be equivalent, electronic, electric/electronic, low-voltage electric.

Sequence of operations to be controlled shall be as shown on drawings.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Mechanical materials and equipment to be provided under this contract shall be current standard catalog products of manufacturers regularly engaged in the manufacture of the products.

2.2 MATERIAL AND EQUIPMENT

Mechanical material and equipment shall meet the specified requirements and shall be suitable for the installation shown. Components bearing the same part number shall be identical in form, fit, and function. Materials and equipment shall be new and free from defects.

2.3 VIBRATION ISOLATORS

2.3.1 Pipe and Duct Vibration Isolation

Type G: Isolators shall be devices with in-series contained steel springs and preformed fibrous-glass or chloroprene-elastomer elements for connecting to building-structure attachments. Devices shall be loaded by supported system during operating conditions to produce a minimum spring and elastomer static deflection of 1 inch and 3/8 inch, respectively.

Type H: Isolators shall be devices with contained chloroprene-elastomer elements for connecting to building-structure attachments. Devices shall be loaded by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8 inch.

Type J: Isolators shall be devices with elastomers mounted on floor-supported columns or directly on the floor. Devices shall be loaded by supported system during operating conditions to produce a minimum

elastomer static deflection of 3/8 inch.

2.3.2 Floor-Mounted Piping

Type K: Isolators shall be devices with springs mounted on floor-supported columns or directly on the floor. Devices shall be loaded by supported system during operating conditions to produce a minimum spring static deflection of 1 inch.

2.3.3 Vertical Piping

Type L: Isolators shall be pipe base-support devices with one or more contained steel springs. Devices shall be loaded by supported system during operating conditions to produce a minimum static deflection of 1 inch Devices shall be equipped with precompression and vertical-limit features, as well as a minimum 1/4-inch thick elastomer sound pad and isolation washers, for mounting to floor.

Type M: Isolators shall be elastomer mounted baseplate and riser pipe-guide devices. Elastomer elements shall be contained double acting, and elastomers under rated load shall have a minimum static deflection of 3/8 inch. Isolator shall be sized to accommodate thermal insulation within the stationary guide ring.

2.4 INSULATION

Thermal-insulation system materials shall be noncombustible, as defined by NFPA 220.

Surfaces to be insulated, extent of insulation, and thickness of insulation shall be as indicated on the contract drawings.

Insulation thickness and duct sizes are in inches. Nominal duct thickness sizes are internal dimensions. Pipe callouts are nominal pipe sizes in inches.

Fibrous glass blanket and board insulation shall have a thermal conductivity less than 0.27 BTU inch/HR/square foot/degree F at operating temperature, a density greater than 1 pound per cubic foot. Insulation shall conform to ASTM C 1139.

Cellular elastomer shall have a minimum thermal conductivity less than 0.27 BTU inch/HR/square foot/degree F/inch.

2.4.1 Adhesives

Adhesives shall be as recommended by the insulation manufacturer.

2.4.2 Jacketing

Jacketing shall be as recommended by the insulation manufacturer.

2.4.3 Coatings

Coatings shall be as recommended by the insulation manufacturer.

Coating color shall be as selected by the Contracting Officer.

2.5 COILS

2.5.1 Coil Pressure and Temperature Ratings

Coils shall be designed for the following fluid operating pressures and temperatures:

SERVICE	PRESSURE (PSI)	TEMPERATURE (DEGREES F)
Steam - low pressure	25	267

Coils shall be air-pressure tested under water at following minimum pressures:

SERVICE	PRESSURE (PSI)
Steam (low and high pressure)	250

2.5.2 Coil Casings

Coil casing shall be mill-galvanized sheet metal with not less than 1.25 ounces of zinc per square footof two-sided metal surface conforming to ASTM A 527/A 527M. Minimum shall be 16-gage, and casing shall be flanged on four sides for bolted assembly.

2.5.3 Coil Headers

Coil headers shall be cast iron, brass, copper, or aluminum casting.

Coil shall have same end connections.

Steam coil headers shall be fitted with 1/4-inch ips spring-loaded plug drains and vent petcocks. Automatic vents shall be provided where needed.

2.5.4 Coil Tubing

Coils shall be constructed of copper tubing with aluminum or copper fins. Plate fins shall have spacer collars in metallic contact with the adjacent fin, and fins shall be mechanically bonded to the tube. No bare tube surface shall be visible within the finned portion of the coil.

Heating-coil face tube spacing shall be a maximum of 3 inches on center for 1-inch.

Tubes shall be straight, turns shall be made through headers or return U-bends, and connections and joints shall be brazed.

Coil tube material shall be seamless deoxidized copper.

2.5.5 Testing

Coils shall be factory pressure tested, dehydrated, vacuum tested, purged with inert gas, and sealed, prior to shipment to job site.

2.6 UNIT HEATERS

Unit heaters shall be suspended type and arranged for discharge of air as indicated on the construction drawings.

2.6.1 Casing

Casing shall be manufactured of not less than 20-gage steel. Casing inside and outside shall be given a phosphate pretreatment, primer, and baked enamel finish. Horizontal louvers shall be provided and shall be completely recessed inside of the casing frame and shall be adjustable coil hot dipped galvanized steel fin steam coil, malleable iron header, 200 PSI maximum pressure.

2.6.2 Fans

Fans shall be propeller type, designed and manufactured for unit heater application. Fans shall have a minimum of three aluminum blades.

2.6.3 Motors

Motors shall be totally enclosed.

2.6.4 Propeller Unit Heaters (PUH)

2.7 PACKAGED, SELF-CONTAINED ROOFTOP UNIT

Unit shall be provided complete with frame and enclosure, piping and wiring, necessary controls and safety devices, and operating charge of oil and refrigerant. Refrigerant shall be R-22.

2.7.1 Compressor

Compressor shall be 1,750-revolution per minute (rpm) hermetic type with internal crankcase sight glass and protected motor. A 3,500-rpm compressor is acceptable in units of 20 tons and less. Unit shall be capable of continuous operation under ARI, "Maximum Operating Conditions" and "Load Temperature Operations".

Two compressors shall be provided and shall operate in completely independent refrigerant circuits. The compressors shall be actuated by capacity control relays interlocked with a time sequence switch, and shall start unloaded or with gas pressures across the compressor equalized.

Compressors shall be provided with high/low pressure safety cutoff. Compressor shall be equipped with reversible oil pump for lubrication, an oil-pressure-failure switch and gage, crankcase heaters, suction and discharge flanged valves, head pressure, and suction pressure gages with shutoff valves. System selection shall limit the compressor power input to 1.2 kilowatts per ton of refrigeration at standard ARI conditions. Compressor shall be mounted on spring-type vibration isolators.

2.7.2 Cooling Coil

For compressors with capacity reduction, the associated coil shall be provided with a separate circuit, liquid solenoid valve, and an expansion device for each two stages of capacity reduction. For each compressor of a dual-compressor unit, the associated coil shall be provided with a protected, insulated drain pan. Tubes shall be seamless copper, and fins shall be aluminum, mechanically bonded to the tube at 12 fins per inch,

maximum. Coils shall be equipped with liquid-feed distributors to ensure equal feed to each refrigerant circuit. Coils shall be tested at 400 pounds per square inch (psi) at the factory and completely dehydrated. Air flow shall be limited to 500 feet per minute (fpm). Design shall preclude carryover of water.

2.7.3 Fans

Centrifugal-type fans with fan/coil type blades shall be provided in each fan section. Fans shall be mounted on a common shaft. Bearings shall be antifriction type, manufactured from vacuum processed alloys. Bearing shall have L-10 life expectancy rating of 40,000 hours under service load conditions. Fans shall be statically and dynamically balanced. Fans shall be V-belt driven by constant-speed motor of sufficient size that the brake power rating shall not exceed the nominal motor rating. Adjustable sheave shall provide not less than 20 percent fan-speed adjustment. Sheave size shall be selected so that fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity.

2.7.4 Casing

Outer casing shall be constructed of insulated 18-gage metal panels adequately reinforced with formed metal frame, and provided with easily removable access panels located for access to all parts of the equipment. Corners shall be rounded to provide a neat appearance. All metal surfaces shall be Bonderite treated, phosphatized, and have a baked enamel finish. Casing and insulation shall be designed to limit noise and vibration within acceptable levels.

2.7.5 Controls

Refer to drawing and Section 15972.

2.7.6 Filters

Filters shall be located in the filter return air fixture. Filters shall limit air velocities to 500 fpm. Filter shall have an average efficiency of not less than 45 percent based on a National Bureau of Standards (NBS) performance test using 96-percent Cottrell precipitate and 4-percent cotton lint. Filter shall have an initial resistance not to exceed 0.12-inch water gage (wg) at 380 fpm and shall be capable of holding at least 400 grams of NBS test contaminant before the pressure drop exceeds 0.5 inch wg.

Filters shall be 2 inch thick panel, glass-fiber type, housed in a fiberboard casing between metal grids. Stiffener bar shall be provided for additional support. Filtering medium shall be formed of continuous interlaced glass filaments. Fiber shall be coated with a nonflammable fluid jell that forms an adhesive film to hold collected dust. Fluid jell shall not drip at temperatures below 150 degrees F.

2.7.7 Air-Cooled Condenser

Condenser coil shall be an extended surface fin-and-tube type, constructed with copper tubes with aluminum fins mechanically bonded to coil. Entire refrigerant circuit shall be dehydrated and sealed at the factory.

Fans shall be propeller type. Fans shall be directly connected to low-speed (1,200 rpm maximum) electric motors. Belt drive shall be provided with guard and adjustable sheaves to provide not less than 20

percent fan speed adjustment. Sheaves shall be selected to provide the capacity indicated at the approximate midpoint of the adjustment.

Electric motor shall be totally enclosed. Motor starter shall be magnetic across-the-line type within a weather-resistant housing.

Condenser enclosure shall be constructed of not less than 18-gage with access panels and with rust-inhibitive baked enamel.

2.8 DUCTWORK

2.8.1 Galvanized Steel Ductwork Materials

Galvanized steel ductwork sheet metal shall be carbon steel, of lock-forming quality, hot-dip galvanized, with regular spangle-type zinc coating, conforming to ASTM A 527/A 527M, G90. All exposed ductwork shall be treated by phosphatizing to provide a paint grip finish.

Sheet metal thickness and reinforcement thickness shall conform to SMACNA-06.

2.8.1.1 Duct Hangers

Duct hangers in contact with galvanized duct surfaces shall be galvanized steel.

2.8.2 Mill-Rolled Reinforcing and Supporting Materials

Mill-rolled structural steel shall conform to ASTM A 36/A 36M and, wherever in contact with sheet metal ducting, shall be galvanized to commercial weight of zinc or coated with materials conforming to ASTM A 123.

Equivalent strength, proprietary design, rolled-steel structural support systems may be submitted for approval in lieu of mill-rolled structural steel.

2.8.3 Components

2.8.3.1 Round, Double-Wall Sheet Metal Ducts

Ducts and fittings shall be shop fabricated.

Construction shall comprise an airtight, vapor barrier, outer pressure shell, a 1-inch insulation layer, and a solid-metal inner liner that completely covers the insulation throughout the system.

Insulation shall conform to NFPA 90A and ASTM C 1071. Thermal conductivity shall be in accordance with ASTM D 257.

2.8.4 Duct and Fitting Gages

Outer pressure shell shall be as specified in ASHRAE-06 Chapter 16, ASHRAE-03, Chapter 32 and SMACNA-06; the inner liner shall be as recommended by the manufacturer but not lighter than 26-gage.

2.8.5 Reinforcement

Inner liners of both duct and fittings shall be supported by metal spacers welded in position to maintain spacing and concentricity.

2.8.6 Fittings

Divided flow fittings shall be made as separate fittings, not tap collars into duct sections, with the following construction requirements:

Sound, airtight, continuous welds at intersection of fitting body and tap

Tap liner securely welded to inner liner, with weld spacing not to exceed 3 inches

Insulation shall be packed around the branch tap area for complete cavity filling.

Branch connection shall be carefully fit to cutout openings in inner liner without spaces for air erosion of insulation and without sharp projections that cause noise and airflow disturbance.

Seams in the pressure shell of fittings shall be continuously brazed. Galvanized areas that have been damaged by welding shall be protected with manufacturer's standard corrosion-resistant coating.

Offset configurations shall be submitted for approval.

Elbows shall be two-piece type for angles through 35 degrees, three-piece type for angles 36 through 71 degrees, and five-piece type for angles 72 through 90 degrees.

Crosses, increasers, reducers, reducing tees, and 90-degree tees shall be conical type.

Diffuser take offs shall be constructed according to manufacturer's recommendations. Diffuser mounting flange shall be folded inward to provide proper mounting surface.

2.8.7 Turning Vanes

Turning vanes shall be double-wall type, commercially manufactured for system service.

2.8.8 Dampers

Low pressure drop, manual volume dampers shall be constructed in accordance with ASHRAE-06, Chapter 16, ASHRAE-03, Chapter 32 and SMACNA-06.

2.8.9 Flexible Duct Materials

Flexible duct connectors shall be in accordance with UL 181, Class 1 material and shall comply with NFPA 90A.

Wire-reinforced fibrous-glass duct shall consist of a minimum 1-pound per cubic foot density fibrous glass bonded to and supported by corrosion-protected spring helix. Vapor barrier shall be a 4-mil minimum, pigmented polyvinylchloride film. Duct shall be bendable without damage through 180 degrees with an inside bend radius not greater than two duct diameters. Minimum wall thickness shall be 1 inch. Thermal conductivity shall be not greater than 0.23 Btu foot per hour per square foot per degrees F at 75 degrees F mean. Permeance shall be not greater than 0.10 perm. Working pressure range shall be from minus 1/2-inch water gage (wg)

to plus 1-1/2 inches wg; working temperature shall range from minus 20 to plus 250 degrees F. Minimum sustained velocity without delamination shall be 2,400 fpm. Materials shall conform to NFPA 90A. Acoustic properties shall be submitted for approval.

2.8.10 Manual Volume Dampers

Volume damper construction shall conform to SMACNA-06.

Dampers shall be equipped with an indicating quadrant regulator having a locking feature externally located and easily accessible for adjustment. Where damper rod lengths exceed 30 inches, a regulator shall be provided at each end of damper shaft.

Damper shafts shall have two-end bearings.

Splitter damper shall be 22-gage sheet metal, or 2 gages heavier than duct in which installed; i.e., 20-gage splitter in 22-gage duct, up to 16-gage maximum. Hinges shall be full length piano-type or 1/8-inchthick door type.

Damper shaft shall be full length and shall extend beyond damper blade. A 3/8-inch square shaft shall be used for damper lengths up to 20 inches and a 1/2-inch square shaft shall be used for damper lengths 20 inches and larger. Where necessary to prevent damper vibration or slippage, adjustable support rods with locking provisions external to duct shall be provided at damper blade end.

Dampers in ducts having a width perpendicular to the axis of the damper that is greater than 12 inches shall be multiblade type having a substantial frame with blades fabricated of 16-gage metal. Blades shall not exceed 10 inches in width and 48 inches in length and shall be pinned or welded to 1/2-inch diameter shafts. Dampers greater than 48 inches in width shall be made in two or more sections with intermediate mullions, each section being mechanically interlocked with the adjoining section or sections. Blades shall have graphite-impregnated nylon or oil-impregnated sintered bronze bearings and shall be connected so that adjoining blades rotate in opposite directions.

2.8.10.1 Flexible Connectors for Sheet Metal

Connectors shall be UL-listed, 20-ounce per square foot, fire-retardant, airtight, woven fibrous-glass cloth impregnated with chloroprene. Clear width, not including clamping section, shall be within 6 to 8 inches.

2.8.10.2 Fire Dampers

2.9 AIR DIFFUSERS

Diffusers and return grilles shall be as specified on drawings.

Supply diffusers shall be provided with combination damper and equalizing grid; damper shall be extracting-splitter type, except where otherwise specified.

Gaskets shall be provided for supply-terminal air devices mounted in finished surfaces.

Color selection shall be from manufacturer's standard color chips and approved by the Contracting Officer.

Low-velocity systems shall encompass ductwork and plenums where maximum air velocity is 2,500 fpm and maximum static pressure is 2 inches wg, positive or negative.

2.9.1 Type Air-Diffusion Devices

Construction of air-diffusion devices shall be specified on drawings.

2.9.1.1 Type DRC

Antismudge ring shall be provided.

2.9.1.2 Type GR

Type and dimensions shall be specified on drawing.

Grilles installed in horizontal surfaces shall have face bars straight and parallel to long dimension.

2.9.1.3 Type RR

Type RR shall be return register, single-deflection type, and shall have fixed face bars with opposed-blade dampers.

Registers installed in vertical surfaces shall have horizontal face bars set downward at approximately 35 degrees from vertical.

Registers installed in horizontal surfaces shall have face bars set straight and parallel to long dimension.

PART 3 EXECUTION

3.1 INSTALLATION

Materials and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers. Installation shall be accomplished by workers skilled in this type of work. Installation shall be so made that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. Emergency switches and alarms shall be installed in conspicuous locations.

Pipe valves and specialties shall be installed in accordance with manufacturer's recommendations and in accordance with paragraphs entitled, "Steel Pipe," "Valves," and "Refrigeration Specialties."

3.2 CLEANING

Exposed surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish painting or are enclosed within the building structure.

Before final acceptance, mechanical equipment, including piping, ducting, and fixtures, shall be clean and free from dirt, grease, and fingermarks.

3.3 AIR HANDLING UNITS

3.3.1 Installation

Coils shall be installed in accordance with the manufacturer's recommendations. Dampers shall be set in a fixed position to provide the outside air quantity scheduled.

3.3.2 Enclosure Test

Services of a competent, factory-trained manufacturer's representative shall be provided to supervise assembly, inspection, and testing of the enclosure.

Enclosure rigidity shall be tested by starting and stopping fans. No audible enclosure popping noise, deflection, or deformation in excess of specified limits shall result.

3.4 DUCTWORK

3.4.1 Preparation

Sheet metal construction shall be provided in accordance with the recommendations for best practices in ASHRAE-06, Chapter 16, SMACNA-06, NFPA 90A, and ASHRAE-03, Chapter 32.

Where construction methods for certain items are not described in the referenced standards or herein, the work shall be performed in accordance with recommendations for best practice defined in ASHRAE-06.

Sheet metal surfaces to be painted and surfaces to which adhesives are to be applied shall be clean and free of oil, grease, and deleterious substances.

Duct strength shall be adequate to prevent failure under service pressure or vacuum created by fast closure of duct devices. Leaktight, automatic relief devices shall be provided.

Supplementary steel shall be designed and fabricated in accordance with AISC S328.

3.4.2 Installation

Fabrication shall be airtight and shall include reinforcements, bracing, supports, framing, gasketing, sealing, and fastening to provide rigid construction and freedom from vibration, airflow-induced motion and noise, and excessive deflection at specified maximum system air pressure and velocity.

Where ducts pass through firewalls, a flanged duct segment with fire damper and access door shall be provided in that surface during surface construction.

3.5 APPLICATION

3.5.1 Round Sheet Metal Ducts

3.5.1.1 Duct Gages, Joints, and Reinforcement

Sheet metal minimum thickness, joints, and reinforcement between joints shall be in accordance with ASHRAE-06, Chapter 16, ASHRAE-03, Chapter 32

and SMACNA-06.

Longitudinal duct joint shall be manufactured by machine, with spiral lockseams to and including 60-inch diameters, and to dimensional tolerances compatible with fittings provided.

Ducts shall have supplemental girth angle supports, riveted with brazed to duct. Girth angles shall be located as follows:

DIAMETER, INCHES	REINFORCEMENT-MAXIMUM SPACING, INCHES
25 to 36	1-1/4 by 1-1/4, 1/8 thick, 72 inches on center

Draw band girth joints are not acceptable.

Slip joints shall be made up by coating the male fitting with elastomer sealing materials, exercising care to prevent mastic from entering fitting bore, leaving only a thin annular mastic line exposed internally. Sheet metal screws shall be used to make assembly rigid, not less than four screws per joint, maximum spacing 6 inches. Pop rivets shall not be used. All joints shall be taped and heat sealed.

Bolt heads and nuts shall be hex-shaped, 5/16-inch diameter for ducts up to 50-inch diameter, and 3/8-inch diameter for 51-inch diameter ducts and larger.

Flanges shall be brazed to duct on outside of duct and intermittently welded with 1-inch welds every 4 inches on inside joint face. Excess filler metal shall be removed from inside face. Galvanized areas that have been damaged by welding shall be protected with manufacturer's standard corrosion-resistant coating.

3.5.2 Round, Sheet Metal Duct Installation

3.5.2.1 Joints

An inner coupling shall be provided to align the inner lining to maintain good airflow conditions equivalent to standard round high-pressure duct joints. Butt joints are not suitable for the inner liner. This alignment shall be accomplished by extending the liner of the fitting for slip joint into the pipe or by the use of a double concentric coupling with the two couplings held by spacers for rigidity and wall spacing. For ducts over 34 inches inside diameter, a separate coupling for inner alignment, with the pressure shells joined by angle-ring flanged connections, shall be provided.

3.5.2.2 Insulation Ends

At the end of an uninsulated section or run where internally insulated duct connects to uninsulated spiral duct, fitting, fire damper or flexible duct, an insulation end-fitting shall be installed to bring the outer pressure shell down to nominal size.

3.5.3 Access Openings

Access panels shall be installed in ductwork adjacent to smoke detectors.

Minimum size of access opening shall be 12 by 18 inches, unless precluded by duct dimension.

Access openings shall be framed by welded and ground miter joint, 1/8-inch thick strap or steel or angle iron, with 3/8-inch studs welded to frame. Cover plate shall be not less than 16-gage, reinforced as necessary for larger sizes constructed of 12-gage metal.

In lieu of access doors, readily accessible flanged duct sections may be provided upon approval. Stable hanger supports shall be provided for disconnected duct termini.

3.5.4 Duct Supports

Duct support shall be installed in accordance with ASHRAE-06, Chapter 16, ASHRAE-03, Chapter 32 and SMACNA-06. Duct hangers shall meet the minimum size specified in ASHRAE-06, Chapter 16, ASHRAE-03, Chapter 32 and SMACNA-06. Two hangers shall be provided where necessary to eliminate sway. Support attachment to duct surfaces, shall be by solid rivet or bolt or welding 4 inches on center.

Round, double-wall duct supports shall be as recommended by the manufacturer except that minimum hanger ring and strap size shall be 1-1/2 inches by 1/8 inch.

Selection of hanging system shall be at the Contractor's option, and shall take into account the location and precedence of work under other sections, interferences of various piping and electrical conduit, equipment, building configuration, structural and safety factor requirements, vibration, and imposed loads under normal and abnormal service conditions. Support sizes, configurations, and spacings are given to show the minimal type of supporting components required. If installed loads are excessive for the specified hanger spacing, hangers, and accessories heavier-duty components and shall be provided. Hanger spacing shall be reduced. After system startup, any duct support device which, due to length, configuration, or size, vibrates or causes possible failure of a member, shall be replaced or the condition shall otherwise be alleviated. Special care shall be exercised to preclude cascade-type failures.

Hanger rods, angles, and straps shall be attached to beam clamps. Concrete inserts, masonry anchors, and fasteners shall be approved for the application.

Hardened high-carbon spring-steel fasteners fitted onto beams and miscellaneous structural steel are acceptable upon prior approval of each proposed application and upon field demonstration of conformance to specification requirements.

Hanger spacing shall provide a 20-to-1 safety factor for supported load.

Maximum load supported by any two fasteners shall be 100 pounds.

Friction rod assemblies are not acceptable.

Ductwork and equipment shall not be hung from roof deck, piping, or other ducts or equipment. Maximum span between any two points shall be 10 feet, with lesser spans as required by duct assemblies, interferences, and permitted loads imposed.

There shall be not less than one set of hangers for each point of support. Hangers shall be installed on both sides of all duct turns, branch

fittings, and transitions.

Hangers shall be sufficiently cross braced to eliminate sway vertically and laterally.

Rectangular ducts up to 36 inches shall be supported by strap-type hangers attached at not less than three places to not less than two duct surfaces in different planes.

Perforated strap hangers are not acceptable.

Rectangular ducting, 36 inches and larger, shall be supported by trapeze hangers. Ducts situated in unconditioned areas and required to have insulation with a vapor-sealed facing shall be supported on trapeze hangers. Hangers shall be spaced far enough out from the side of the duct to permit the duct insulation to be placed on the duct inside the trapeze. Duct hangers shall not penetrate the vapor-sealed facing.

Where trapeze hangers are used, the bottom of the duct shall be supported on angles sized as follows:

WIDTH OF DUCT, INCHES	MINIMUM BOTTOM ANGLE SIZE, INCHES
30 and smaller	1-1/4 by 1-1/4 by 1/8
31 to 48	1-1/2 by 1-1/2 by 1/8
49 to 72	1-1/2 by 1-1/2 by 3/16
73 to 96	2 by 2 by 1/4
97 and wider	3 by 3 by 1/4

Where ductwork system contains heavy equipment, excluding air-diffusion devices and single-leaf dampers, such equipment shall be hung independently of the ductwork by means of rods or angles of sizes adequate to support the load.

Ducting, when supported from roof purlins, shall not be supported at points greater than one-sixth of the purlin span from the roof truss. Load per hanger shall not exceed 400 pounds when support is from a single purlin or 800 pounds when hanger load is applied halfway between purlins by means of auxiliary support steel provided under this section. When support is not halfway between purlins, the allowable hanger load shall be the product of 400 times the inverse ratio of the longest distance to purlin-to-purlin spacing.

When the hanger load exceeds the above limits, reinforcing of purlin(s) or additional support beam(s) shall be provided. When an additional beam is used, the beam shall bear on the top chord of the roof trusses, and bearing shall be over gusset plates of top chord. Beam shall be stabilized by connection to roof purlin along bottom flange.

Purlins used for supporting fire-protection sprinkler mains, electrical lighting fixtures, electrical power ducts, or cable trays shall be considered fully loaded, and supplemental reinforcing or auxiliary support steel shall be provided for these purlins.

Duct supports shall be vibration isolated from structure at points

indicated.

Vibration isolators shall be provided in discharge ducting system for a distance not less than 50 feet beyond the air handling unit. Deflection of duct and equipment mountings shall be coordinated.

3.5.5 Flexible Connectors for Steel Metal

Air-handling equipment, ducts crossing building expansion joints, and fan inlets and outlets shall be connected to upstream and downstream components by treated woven-cloth connectors.

Connectors shall be installed only after system fans are operative and all vibration isolation mountings have been adjusted. When system fans are operating, connectors shall be free of wrinkles caused by misalignment or fan reaction. Width of surface shall be curvilinear.

3.5.6 Duct Probe Access

Holes shall be provided with neat patches, threaded plugs, or threaded or twist-on caps for air-balancing pitot tube access. Extended-neck fittings shall be provided where probe access area is insulated.

3.5.7 Openings in Roofs and Walls

Building openings are fixed as indicated in the equipment room layout drawings and equipment shall be provided to suit. Contractor may propose to alter these openings upon prior approval by the Contracting Officer and at his expense.

Openings indicated in outside walls and roof are approximate. Within 30 days after the award of contract, detail drawings showing exact opening dimensions and location of the equipment shall be submitted to the Contracting Officer for approval.

3.5.8 Ductwork Cleaning Provisions

Open ducting shall be protected from construction dust and debris in a manner approved by the Contracting Officer. Dirty assembled ducting shall be cleaned by subjecting main and branch interior surfaces to air streams moving at velocities two times the specified working velocities, at static pressures within maximum ratings. This may done with filter-equipped, wheel mounted, portable blowers; compressed-air operated perimeter lances that direct the compressed air and which are pulled in the direction of normal air flow; or other means approved by the Contracting Officer. Compressed air used for cleaning ducting shall be water- and oil-free. Prior to acceptance, dust and debris shall be removed from exterior surfaces.

3.5.9 Fire Damper Tests

Operation tests shall be performed on each fire damper in the presence of the Contracting Officer by activating fusible link with localized heat. New links shall be provided and installed after successful testing.

3.6 FILTERS

Filter supports and retention elements shall be coordinated to provide a substantial, structurally sound, leakproof installation. Filter

arrangements shall be as indicated in the manufacturer's catalog data.

Holding frames shall be gasketed on perimeter, or calked to each other, to supplementary steel, or to closures with elastomeric compounds recommended by the filter manufacturer. Substrate shall be prepared in accordance with the elastomer manufacturer's instructions, including the priming of surfaces in areas where the elastomer is not confined.

3.7 CONTROLS

3.7.1 Installation

Installation of control components shall be done by Contractor-certified control and instrumentation specialists or factory representatives shall comply with Section 15972, "Direct Digital Control Systems".

3.8 AIR-HANDLING SYSTEMS TESTING

Tests shall be performed prior to insulation of surfaces, painting, and concealment of work.

3.8.1 Low-Velocity Duct Systems

Portions of systems shall be inspected and tested to positive or negative pressures, or both, whichever is normal to the portion of system under test, to verify the following:

There are no visible mechanical defects.

There is no audible leakage at any point when area ambient noise is at normal-occupancy level.

No leakage is perceptible to the hand, when placed within 6 inches of a joint.

3.9 AIR AND HYDRONIC SYSTEMS TESTING, AND ADJUSTMENT

Operational balancing and adjustment of air-handling and hydronic systems shall be performed under the direction of an independent balancing agency whose field representative is a registered professional engineer. Work shall be done in accordance with ASHRAE-06, Chapter 1, AABC MN-1or SMACNA-07, where applicable, the requirements of the contract documents, and in the presence of the Contracting Officer.

3.9.1 Air-Handling Systems

Final volume conditions for all systems shall be within plus or minus 5 percent of the conditions indicated on contract drawings.

Balancing and adjustment apparatus, procedures and test report shall be in accordance with Section II of ASHRAE-06, Chapter 1, AABC MN-1or SMACNA-07.

3.10 STEAM AND CONDENSATE SYSTEMS TESTING

Prior to acceptance of the work, completed systems shall be tested in the presence of the Contracting Officer.

System shall be subjected to pressure tests to determine structural integrity, and to operational and cyclic tests, as necessary, to determine

that system functions and operates as required.

After pressure tests and cleaning operations have been satisfactorily completed, system components shall be adjusted for proper operation within the design and operating characteristics published by the component manufacturer. In addition to requiring the services of an authorized representative of the manufacturer, the Government reserves the right to require the services of an authorized representative of a component manufacturer if the Contractor is unable to adjust a component. The Contractor shall arrange for such services at no additional cost to the Government.

3.10.1 Test Duration

Duration of a test will be determined by the Contracting Officer.

A pressure test shall be held for a minimum of 2 hours and a maximum of 24 hours.

Test may be terminated by the Contracting Officer at any time after it has been determined that the system meets specified requirements.

3.10.2 Test Gages

Contractor's test gages shall conform to ASME B40.1 and shall have a current calibration certification.

3.10.3 Acceptance Pressure Testing

Testing shall take place during steady-state ambient temperature conditions.

Tests shall be hydrostatic unless otherwise specified or approved by the Contracting Officer.

Systems shall be tested at 1-1/2 times primary working steam pressure (wsp) rating of system components, and the applied pressure shall be maintained. System shall be monitored for a minimum of 1 hour in the presence of the Contracting Officer to detect any leakage.

Components that could be damaged by shock or test pressure shall be removed from piping systems prior to hydrostatic testing.

Movement limiting provisions shall be used to protect expansion joints against overextension from system pressures.

Piping system components, such as valves, shall be checked for functional operation under system test pressure.

3.10.4 Operational Testing

System shall be cycled three times, from start to operating thermal conditions, to verify adequacy of construction, system controls, and component performance.

3.10.5 Test Records

Contractor shall prepare and maintain test records of systems tests. Records shall show test-personnel responsibilities, dates, test gage identification numbers, ambient and test temperatures, pressure ranges,

rates of pressure drop, leakage rates, and other system characteristics.

-- End of Section --

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SECTION 15972

DIRECT DIGITAL CONTROL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.5	(1996) (Errata 1988) (Addenda 1992) Pipe Flanges and Flanged Fittings
ASME B31.1	(1998) Power Piping

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126	(1995) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 72	(1999) National Fire Alarm Code
NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 506	(2000) UL Standard for Safety Specialty Transformers
UL 916	(1998) Energy Management Equipment
UL 1449	(1996) Transient Voltage Surge Suppressors

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following

items:

DDC Hardware
DDC Capabilities Workstation Software
Input Devices Output Devices
Surge and Transient Protection
Smoke Detectors
Panel Mounted Display and Keypad

Submit manufacturers' specification sheets for each type of equipment to show compliance with the project specification. For each type of equipment, highlight each compliance item and reference each item to the relevant specification paragraph number. Submit sufficient manufacturers' information to allow verification of compliance by the Contracting Officer.

Equipment and software for which specification compliance data shall be submitted include the following:

DDC Hardware
I/O Devices
Communications Ports
Protected Memory
Operating Temperature Limits

DDC Capabilities

Communications; baud rates, communication ports, stand-alone

Trending
Alarming
Messages
Self diagnostics; identification of a failed module
PID Control

Input Devices

Transmitters
Temperature Sensors
Humidity Sensors
Pressure Sensors
Flow or Motor Status
Sensor Wells

Output Devices

Dampers
Valves
Actuators
Control Relays

Surge and Transient Protection

Power Line

Provide administrative and closeout submittals;

Training course documentation: Training course documentation shall include three manuals. Documentation shall include an

agenda, defined objectives for each lesson and detailed description of the subject matter of each lesson.

Service organization: Qualified service organization list shall include the names and telephone numbers of organizations qualified to service the HVAC control systems.

SD-04 Drawings

Control System Schematic
Ladder Diagrams
Component Wiring Diagrams
Terminal Strip Diagrams

Drawings shall be prepared by use of Autocad Version 14 (Autodesk Inc., CADD Software) and provided in drawing file format (.DWG) on 3.5 inch 1.44 Mb disks for DOS application.

Control System Schematic

Provide control system schematic that includes the following:

Location of each input and output device

Flow diagram of each HVAC component, for instance flow through coils, fans, dampers

Name or symbol for each component such as V-1, DM-2, T-1 for a valve, damper motor, and temperature sensor, respectively

Setpoints

Sensor range

Actuator range

Valve and damper schedules and normal position

Switch points on input switches

Written sequence of operation for each schematic

Schedule identifying each sensor and controlled device with the following information:

Software point name

Point type (AO, AI, DO, DI)

Point range (4 to 20 ma, 100 or 1000 ohm platinum RTD, 10,000 ohm thermistor)

Digital controller number to which the point connects.

Electrical Equipment Ladder diagrams

Submit a wiring diagram for each type of input device and each type of output device. Diagram shall show how the device is wired and powered; showing typical connections at the digital controller

and each power supply, as well as at the device itself. Show for all field connected devices, including, but not limited to, control relays, motor starters, electric or electronic actuators, and temperature, pressure, flow, proof, and humidity sensors and transmitters.

Terminal Strip Diagrams

Submit a diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.

Design Data

Temperature sensor accuracy

Temperature sensor stability

Submit test data demonstrating the following installed components will meet specification requirements.

Temperature Sensor Accuracy

Submit manufacturer specification of temperature sensor accuracy. Literature shall make clear sensor accuracy as specified.

Temperature Sensor Stability

Provide manufacturer specification of five year stability of RTDs and thermistors. Literature shall make clear sensor stability as specified.

As-Built Drawings shall be submitted for all Controls and Accessories providing current factual information including deviations and amendments to the drawings.

SD-19 Operations and Maintenance Manual

DDC Hardware Manufacturers' Manuals: Provide the following manuals:

Specifications of Components
Installation Instructions
Operation Instructions
Service
Sensor and Control Components Manual
Operator's Manual

Sensor and Control Components Manual: Submit detailed information of control system components external to the field installed digital controllers. Submit manufacturers' manuals detailing specifications, installation, maintenance, and calibration.

Operator's Manual: Submit the following information necessary to operate the direct digital control system.

Initializing Digital Controllers: Include documentation for set-up, from scratch, of the digital controllers. Include shop drawings showing cable connections, dip switch settings, and each

equipment setting essential for proper operation of each digital controller. Include information necessary to initialize the digital controllers to a point they can accept control programs from a computer.

Uploading and Downloading Controller Software: Include step by step procedures for uploading and downloading control programs to/from digital controllers and directly connected computer.

Point Set-up Documentation: Include complete documentation for the software setup, on a controller by controller basis, of every physical and virtual point. This includes point name, point type, point description, point location (if a physical I/O point), span, offset, slope, intercept, change of value, and any other characteristic used to define the point.

Scheduling and Set Point Adjustment: Include step-by-step procedures for making set point and equipment scheduling changes through direct connection to a digital controller.

Controller Diagnostics: Include documentation describing running and analyzing controller diagnostics. Define LED indicators.

Alarms and Messages: List alarms and messages programmed into the digital controllers. Describe probable causes of all alarms.

PID Loop Tuning: Include PID loop tuning procedures for the control system.

1.4 RELATED REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

1.5 STORAGE

Stored products shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

1.6 QUALITY ASSURANCE

1.6.1 Standard Products

Material and equipment shall be standard products of manufacturers regularly engaged in the manufacturing of such product, using similar materials, design and workmanship.

The equipment items shall be supported by a service organization.

1.6.2 Nameplates and Tags

Nameplates bearing legends as shown and tags bearing device unique identifiers as shown shall be engraved or stamped. Nameplates shall be permanently attached to HVAC control panel doors.

For each field mounted piece of equipment, not in a finished area, a plastic or metal tag with equipment name and point identifier shall be attached.

1.6.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6.4 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, and shall furnish all work necessary to meet such conditions.

1.6.5 Modification of References

The advisory provision in ASME B31.1 and NFPA 70 shall be considered mandatory. Substitute the word "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" and "owner" to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 DDC SYSTEM

Provide a DDC system as a distributed control system. The system shall have stand-alone digital controllers.

All stand-alone controllers not connected to the operator workstation at Building 1215, shall be wired with a jumper and programmed for load shedding of equipment upon receiving a normally open signal from a Government installed binary input.

Provide an operator programmable system, based on the user applications, to perform closed-loop, modulating control of building equipment. Connect all digital controllers through the communication network to share common data.

Provide an RS-232 or RS-485 communication link to the telephone backboard utilizing a single twisted wire pair, for future connection by the Government.

The new DDC control system shall be fully compatible with one of the existing energy management control systems listed following:

Johnson Metasys Version 9.0
Trane Tracer - Access Version 4.2
Robertshaw DMS-FMS Version 10.9

The above listed systems are located in the EMCS office in Building 1215, Langley Research Center. Each system has its own dedicated graphical workstation.

The Contractor shall provide all necessary software and shall configure a Government-owned laptop computer to communicate with each controller through the communication port to configure and troubleshoot the device.

All cables, additional software, and adapters necessary for these communication connections shall be provided by the Contractor.

The new DDC control system shall not use any integrators, gateways, or interfaces in order to be fully compatible with one of the existing EMCS.

Provide the quantity of digital controllers indicated on the drawings that will perform required climate control, energy management, and alarm functions. All material used shall be currently in production.

2.1.1 Direct Digital Controllers

DDC hardware shall be UL 916 rated.

2.1.1.1 Distributed Control

Apply digital controllers in a distributed control manner.

2.1.1.2 I/O Point Limitation

Total number of I/O hardware points connected to a single stand-alone digital controller shall not exceed 36. I/O expansion units are not permitted. Multiplexing of I/O is not permitted.

2.1.1.3 Environmental Operating Limits

Provide digital controllers that operate in environmental conditions between 32 and 120 degrees F .

2.1.1.4 Stand-Alone Control

Provide stand-alone digital controllers.

2.1.1.5 Memory

Provide sufficient memory for each controller to support required control and communication functions.

Memory Protection: Programs residing in memory shall be protected either by using EEPROM or battery. The backup power source shall have sufficient capacity to maintain volatile memory in event of an AC power failure for a minimum of seventy-two hours.

2.1.1.6 Inputs

Provide input function integral to the direct digital controller. Provide input type as required by the DDC design.

Analog Inputs: Allowable input types are three wire 100 ohm or higher platinum resistance temperature detectors (RTDs), stable 10,000 ohm thermistors, and 4 to 20 mA. Thermistor and direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall be a minimum of 10 bit resolution.

Digital Inputs: Digital inputs shall sense binary state indications such as open/close and on/off.

2.1.1.7 Outputs

Provide output function integral to the direct digital controller. Provide output type as required by the DDC design.

Analog Outputs: Provide controllers with a minimum output resolution of 8 bits. Output shall be 4 to 20 mA.

Digital Outputs: Provide contact closure with contacts rated at a minimum of 1 ampere at 24 volts.

2.1.1.8 PID Control

Provide controllers with proportional, proportional plus integral, and proportional plus integral plus derivative control capability. Terminal controllers are not required to have the derivative component.

2.1.1.9 Communications Ports

Controller-to-Controller LAN Communications Ports: Controllers in the DDC system shall have the capability to be connected in a communications network. Network may consist of more than one level of local area network and one level may have multiple drops. Communications network shall permit sharing between controllers of sensor and control information, thereby allowing execution of dynamic control strategies and coordinated response to alarm conditions. Minimum baud rate shall be 9600 Baud.

On-Site Interface Ports: Provide a RS-232 communications port for digital controller that allows direct connection of a computer and through which the controller may be fully interrogated. Controller access shall not be limited to access through another controller. On-site interface communication ports shall be in addition to the communications port(s) supporting controller to controller communications. Communication rate shall be 9600 Baud minimum. Controller shall have a communications port supporting direct connection of a computer; a hand held terminal port is not sufficient. The following operations shall be available: downloading and uploading control programs, modifying programs and program data base, and retrieving or accepting trend reports, status reports, messages, and alarms.

Remote Work Station Interface Port: Provide one additional direct connect computer port for permanent connection of a remote operator's work station, unless the workstation is a node on the LAN. All operations possible by directly connecting a computer to a controller at the highest level LAN shall be available through this port.

EMCS Interface Port: Provide one additional direct connect computer port for permanent connection to the EMCS. All operations possible by directly connecting a computer to a controller at the highest level LAN shall be available through this port.

2.1.1.10 Digital Controller Cabinet

Controller cabinet shall protect the controller from dust and be rated NEMA 1, unless specified otherwise. Controller cabinets, or enclosures the controller is mounted in shall be lockable.

2.1.1.11 Main Power Switch

Controller shall have a main power switch for isolation of the controller from AC power. The switch shall be protected from tampering within the DDC cabinet. Controller shall be labeled to indicate which panel circuit number disconnects the controller.

2.1.2 Terminal Control Units (TCU)

TCUs shall be manufactured by the same company as the digital controllers. TCUs shall automatically start-up on return of power after a failure, and previous operating parameters shall exist or shall be automatically downloaded from a digital controller on a higher level LAN.

TCUs do not require an internal clock, if they get time information from the digital controller.

2.1.3 DDC Software

Software shall reside in the digital controllers and performs control sequences.

2.1.3.1 Sequence of Control

Provide, in the digital controllers, software to execute the sequence of control.

2.1.3.2 Differential

Where equipment is started and stopped or opened and closed in response to some analog input such as temperature, pressure, or humidity, include a differential for the control loop to prevent short cycling of equipment.

2.1.3.3 Motor and Flow Status Delay

Provide an adjustable delay between when a motor is commanded on or off and when the control program looks to the motor or flow status input for confirmation of successful execution of the command.

2.1.3.4 Runtime Accumulation

Provide resettable run time accumulation for each controlled electrical motor.

2.1.3.5 Timed Local Override

Provide user definable adjustable run time for each push of a momentary contact timed local override. Pushes shall be cumulative with each push designating the same length of time. Provide a user definable limit on the number of contact closures summed, such as 6, before the contact closures are ignored. Timed local overrides are to be disabled during occupancy periods.

2.1.3.6 Time Programs

Provide programs to automatically adjust for leap years, and make daylight savings time and standard time adjustments.

2.1.3.7 Scheduling

Each control output point shall be schedulable and its operation based on time of day, day of week, and day of year. Output points may be associated into groups. Each group may be associated with a different schedule. Changing the schedule of a group shall change the schedule of each point in the group. Points may be added to and deleted from groups. Groups may be

created and deleted by the operator.

Provide capability that will allow current schedules to be viewed and modified in a seven day week format. When control program does not automatically compute holidays, provide capability to allow holiday schedules to be entered one full year at a time.

2.1.3.8 Point Override

I/O and virtual points shall be able to be software overridden in the software and commanded to any possible value.

2.1.3.9 Alarming

I/O points and virtual points shall be alarmable. Alarms may be enabled and disabled for every point. Alarm limits shall be adjustable on analog points. Controllers connected to an external communications device such as a printer, terminal, or computer, shall download alarm and alarm message when alarm occurs. Otherwise, alarms will be stored and automatically downloaded when a communications link occurs. The following conditions shall generate alarms:

a. Motor is commanded on or off but the motor status input indicates no change

b. Room temperature, humidity, or pressure strays outside selectable limits

c. An analog input takes a value indicating sensor failure

d. A module is "dead" to the LAN

e. A power outage occurs

2.1.3.10 Messages

Messages shall be operator defined and assigned to alarm points. Messages shall be displayed when a point goes into alarm.

2.1.3.11 Trending

DDC system shall have the capability to trend I/O and virtual points. Points may be associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range from one minute to 60 minutes at a minimum. Trend data type shall be selectable as either averages over the logging period or instantaneous values at the time of logging. The minimum number of consecutive trend values stored at one time shall be 30 per variable. When trend memory is full, the most recent data shall overwrite the oldest data. Trend data shall be capable of being uploaded to computer. Trend data shall be available on a real time basis; trend data shall appear either numerically or graphically on a connected computer's screen as the data is being processed from the DDC system data environment. Trend reports shall be capable of being uploaded to computer disc and archived.

2.1.3.12 Status Display

Current status of I/O and virtual points shall be displayed on command. Points shall be associated into functional groups, such as all the I/O and

virtual points associated with control of a single air handling unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names; such as AHU-4, Second Floor, Chiller System, and other such names.

2.1.3.13 Diagnostics

Each controller shall perform self-diagnostic routines and provide messages to an operator when errors are detected. DDC system shall be capable of recognizing a nonresponsive module on a LAN. The remaining, responsive modules on a LAN shall not operate in a degraded mode.

2.1.3.14 Power Loss

In event of a power outage, each controller shall assume a disabled status and outputs shall go to an user definable state. Upon restoration of power, DDC system shall perform an orderly restart, with sequencing of outputs.

2.1.3.15 Program Transfer

Provide software for download of control programs and database from a locally connected computer and the EMCS to controllers and upload of same to local computer and EMCS from controllers.

2.1.3.16 Password Protection

Provide at least three levels of password protection to the DDC system permitting different levels of access to the system.

2.1.4 Workstation

The workstation computer is an existing Government owned graphical workstation located in the EMCS office in Facility 1215. The workstation shall not be connected to controller, but shall have the capability of accessing all controllers, including Terminal Control Units (TCUs), in the DDC system.

2.1.5 Panel Mounted Display and Keypad

Provide panel mounted displays and keypads connected to digital controller to communicate with the digital controllers.

2.2 SENSORS AND INPUT HARDWARE

2.2.1 Field Installed Temperature Sensors

2.2.1.1 Resistance Temperature Detectors (RTDs)

Provide RTD sensors with 1000 ohm, or higher, platinum element that are compatible with the digital controllers. Sensors shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degrees F cumulative. Direct connection of RTDs to digital controllers, without transmitters, is preferred provided controller supports direct connection of RTDs. When RTDs are connected directly to the controller, keep lead resistance error to 0.25 degrees F

or less. Provide 3 wire sensing circuits to not exceed the 0.25 degrees F lead resistance error. Total error for a RTD circuit shall not exceed 0.5 degrees F, which includes sensor error, lead resistance error or 4 to 20 milliampere transmitter error, and A/D conversion resolution error. Provide 18 gage twisted and shielded pair cable for both direct connected RTDs and transmitters.

Provide 4 to 20 milliampere transmitters for RTDs where digital controllers do not support direct connection of RTDs to controllers; and/or do not meet temperature resolution requirement of 0.25 degrees F.

2.2.1.2 Thermistors

Precision thermistors may be used in temperature sensing applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degrees F or less between the range of 32 to 150 degrees F. Sensor manufacturer shall utilize 100 percent screening to verify accuracy. Thermistors shall be pre-aged, and inherently stable. Stability error of the thermistor over five years shall not exceed 0.25 degree F cumulative. Sensor element and leads shall be encapsulated. Bead thermistors are not allowed. A/D conversion resolution error shall be kept to 0.1 degrees F. Total error for a thermistor circuit shall not exceed 0.5 degrees F, which includes sensor error and digital controller A/D conversion resolution error. Provide thermistor and digital controller manufacturer documentation and the Contractor's engineering calculations which support the proposed thermistor input circuit will have a total error of 0.5 degree F or less. Provide 18 gage twisted and shielded cable for thermistors.

2.2.1.3 Temperature Sensor Details

Room Type: Conceal element behind protective cover.

Duct Averaging Type: Continuous averaging RTDs for ductwork applications shall be 1 foot in length for each 4 square feet of ductwork cross-sectional area with a minimum length of 6 feet. Probe type duct sensors of 1 foot length minimum are acceptable in ducts 12 feet square and less.

Immersion Type: Three inches total immersion for use with sensor wells, unless otherwise indicated.

Sensor Wells: Brass and stainless steel materials as indicated; provide thermal transmission material compatible with the immersion sensor. Provide heat-sensitive transfer agent between exterior sensor surface and interior well surface.

Outside Air Type: Provide element with sunshade to minimize solar effects. Mount element at least 3 inches from building outside wall. Sunshade shall not inhibit the flow of ambient air across the sensing element. Shade shall protect sensing element from snow, ice, and rain.

2.2.2 Transmitters

Transmitters shall have 4 to 20 mA output linearly scaled to the temperature, pressure, humidity, or flow range being sensed. Transmitter shall be matched to the sensor, factory calibrated, and sealed. Total error shall not exceed 0.1 percent of 20 milliampere (0.02 milliampere) at any point across the 4 to 20 mA span. Supply voltage shall be 24 volts ac or dc. Transmitters shall have noninteractive offset and span adjustments.

For temperature sensing, transmitter stability shall not exceed 0.05 degrees C a year.

2.2.2.1 Spans and Ranges

Transmitter spans or ranges shall be the following and shall be suitable for the application:

a. Temperature:

1. 50 degrees F span: Room, chilled water, cooling coil discharge air, return air sensors

2. 100 degrees F span: Outside air, hot water, heating coil discharge air, mixed air sensors

3. 200 degrees F span: High temperature hot water, heating hot water, chilled/hot water system sensors.

b. Pressure:

1. -0.5 to 0.5 -0.25 to 0.25 inches water differential range: static pressure control of rooms

2. 0 to 5 inches water differential range: Duct static pressure

3. Steam differential pressure

c. Relative Humidity: 0 to 100 percent relative humidity range

2.2.3 Relative Humidity Transmitters

Provide integral humidity transducer and transmitter. Output of relative humidity instrument shall be a 4 to 20 milliampere signal proportional to 0 to 100 percent relative humidity input. Accuracy shall be 2 percent of full scale within the range 20 to 80 percent relative humidity. Sensing element shall be chilled mirror type, polymer, or thin film polymer type. Supply voltage shall be 24 V dc. Transmitter shall meet specified requirements.

2.2.4 Pressure Transmitters

Provide integral pressure transducer and transmitter. Output of pressure instrument shall be a 4 to 20 milliampere signal proportional to the pressure span. Span shall be as specified. Accuracy shall be 1.0 percent. Linearity shall be 0.1 percent. Supply voltage shall be 24 V dc. Transmitter shall meet specified requirements.

2.2.5 Input switches

2.2.5.1 Differential Static Pressure Switch

Provide diaphragm type differential static pressure switches for binary (two-position) operation as specified in sequence of operation. Devices shall withstand pressure surges up to 150 percent of rated pressure. Contacts shall be single pole double throw and switch may be wired for normally open or normally closed operation. Trip set point shall be adjustable. Pressure switch shall be sized so that operating pressure trip point is approximately midpoint of pressure switch adjustable range.

Repetitive accuracy shall be 2 percent.

2.2.5.2 Induced Current Operated Solid State Switches

Provide adjustable ranging to monitor continuous loads up to 200 amperes. Switch shall indicate whether it is normally open or normally closed. Limit off-state leakage to 2 milliampere or less.

2.2.5.3 Timed Local Override

Provide momentary contact push button override with override time set in controller software. Provide to override DDC time of day program and activate occupancy program for assigned units. Upon expiration of override time, the control system shall return to time-of-day program. Time interval for the length of operation shall be software adjustable and shall expire unless reset.

2.2.5.4 Insertion Freeze Protection Switch

Electric switch shall be capillary type. Provide special purpose insertion thermostats with flexible elements a minimum of 20 feet in length for coil face areas up to 40 square feet. Switch contacts shall be rated for motor starter circuit voltage being interrupted. Switch shall be equipped with auxiliary set of contacts for input of switch status to digital controller. Provide additional elements or longer elements for larger coils at the rate of 1 foot length of element per 4 square feet of coil. Serpentine capillary in a plane perpendicular to the air flow to uniformly sense the entire airflow. A freezing condition at 18 inch increments along the sensing element shall activate the thermostatic switch. Switch shall require manual reset after activation.

2.3 OUTPUT HARDWARE

2.3.1 Valves

2.3.1.1 Valve Assembly

Valves shall have stainless steel stems. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall conform to ASME/ANSI B16.5 as a minimum. Cast iron valve components shall conform to ASTM A 126 Class B or C as a minimum.

2.3.1.2 Two-Way Valves

Two-way modulating valves shall have equal percentage characteristics.

2.3.1.3 Valves for Steam Service

Entire bodies for valves 1-1/2 inches and smaller shall be brass or bronze. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze, or iron. Bodies for valves 4 inches and larger shall be iron. Bodies for valves 2-inches and smaller shall have threaded ends. Provide bodies for valves 2-1/2 inches and larger shall with flanged-end connections. Steam valves shall be sized for 13 psig inlet steam pressure with a maximum 8 psi differential through the valve at rated flow, except valves for high pressure service shall be sized for the critical pressure

drop.

2.3.2 Actuator

Provide gear type electric operators with spring return so that, in the event of power failure, actuators shall fail safe in either the normally open or normally closed position as specified. Actuators shall be quiet operating and function properly within the range of 85 to 110 percent of the motive power. When operated at rated voltage, each operator shall be capable of delivering the torque required for continuous uniform movement of the valve and shall have end switch to limit travel or shall withstand continuous stalling without damage. Operators shall function properly with range of 85 to 110 percent of line voltage. Provide gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch pounds. Provide hardened steel running shafts in sleeve bearing of copper alloy, hardened steel, nylon, or ball bearing. Enclose operators and gear trains totally in dustproof housings with rigid conduit connections. Provide two-position operators of the single direction, spring return, or reversing type. Provide proportioning operators capable of stopping at all points in the cycle and starting in either direction, from any point. Provide reversing and proportioning operators with limit switches to limit travel in either direction unless operator is stall type. Equip valve operators with a force limiting device such as spring yield so that, when in a relaxed position, device shall maintain a pressure on valve disc equivalent to system pressure at valve. Provide reversible shaded pole, split capacitor, synchronous, or steper type electric motors.

2.3.3 Output Switches

2.3.3.1 Control Relays

Shall be double pole, double throw (DPDT), UL listed, with contacts rated to the application, and enclosed in a dustproof enclosure. Equip with a light indicator which is lit when coil is energized and is off when coil is not energized. Relays shall be socket type, plug into a fixed base, and be replaceable without need of tools or removing wiring.

All relays and auxiliary relays shall be labeled as to their purpose.

2.4 ELECTRICAL POWER AND DISTRIBUTION

Provide a source 120 volts or less, 60 hz, two-pole, three wire with ground. Devices shall be UL listed or FM approved.

2.4.1 Transformers

Transformers shall conform to UL 506. Provide a fuse cutout on the secondary side of the transformer.

2.4.2 Power Line Surge Protection

Surge suppressors shall be external to digital controller, shall be installed on all incoming AC power. Surge suppressor shall be rated by UL 1449, and have clamping voltage ratings below the following levels:

Normal Mode (Line to Neutral): 350 Volts

Common Mode (Line to Ground): 350 Volts

2.4.3 Wiring

Provide complete electric wiring for temperature control apparatus, including wiring to transformer primaries. Circuits operating at more than 100 Volts shall be in accordance with Section 16145, "Standard Wiring Systems." Use multiconductor cable for concealed accessible locations only. Provide circuit and wiring protection as required by NFPA 70. Protect exposed wiring from abuse and damage.

2.4.3.1 AC Control Wiring

Control wiring for 24 V circuits shall be copper conductor, Teflon insulated with overall Teflon jacket, air plenum rated, non-conduit cable.

Wire size shall be in accordance with the controls system manufacturer's recommendations.

2.4.3.2 Wiring (Direct Digital Controls and Communications)

Wiring shall be single or multiple twisted pair with 100 percent aluminum foil shield, tinned stranded copper conductor, Teflon insulated with overall Teflon jacket, air plenum rated, non-conduit cable.

Wire size shall be in accordance with the controls system manufacturer's recommendations.

Shield shall be grounded with 20 AWG stranded, tinned copper drain wire.

All communication wiring trunks entering and leaving controllers shall be labeled.

Labels shall identify trunk wiring both entering and leaving controllers by direction.

2.5 FIRE PROTECTION DEVICES

Addressable Notifier brand smoke detectors compatible with Government fire alarm system and listed for use in air distribution systems shall be located downstream of the air filters and ahead of any branch connections in HVAC systems. Said detectors shall also be located at each story prior to the connection to a common return and prior to any recirculation of fresh air inlet connection. Installation shall be in accordance with NFPA 90A and NFPA 72 except as amended herein. Duct smoke detectors shall be accessible for cleaning, mounted in accordance with the manufacturer's instructions, and be provided with access doors as specified in NFPA 90A. Said detectors shall be permanently and clearly identified. Duct smoke detector activation shall automatically initiate occupant notification appliances, and shut down their respective fan(s). All low voltage wiring used in conjunction with fire protection devices shall be RED Teflon-coated 4-conductor copper wiring.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under supervision of competent technicians regularly employed in the installation of DDC systems. Provide components for a complete and operational DDC system.

3.1.1 Wiring Criteria

Input/output identification: Permanently label each field wire, cable, or pneumatic tube at each end with the identification specified.

Grounding: Ground controllers and cabinets to a good earth ground. Grounding of the green ac ground wire at the breaker panel alone is not adequate. Run metal conduit from controller panels to adequate building grounds. Ground sensor drain wire shields at controller end.

The Contractor is responsible for correcting all associated ground loop problems.

3.1.2 Digital Controllers

Do not divide control of a single mechanical system such as an air handling unit, boiler, chiller, or terminal equipment between two or more controllers. A single controller shall manage control functions for a single mechanical system. It is permissible, however, to manage more than one mechanical system with a single controller.

Provide digital control cabinets that protect digital controller electronics from dust, at locations shown on the drawings.

Provide a main power switch at each highest level LAN digital controller within controller cabinet.

No multiplexing of points is allowed.

3.1.3 Temperature Sensors

Provide temperature sensors in locations to sense the appropriate condition. Provide sensor where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application such as replacing a duct sensor with a room sensor.

3.1.3.1 Room Temperature Sensors

Provide on interior walls to sense average room temperature conditions. Avoid locations which may be covered by office furniture. Room temperature sensors should not be mounted on exterior walls when other locations are available. Mount center line of sensor at 66 inches above finished floor.

Room temperature sensors shall have a manual override switch.

Provide a DDC communication port on each temperature sensor. Temperature sensors shall not be capable of manual setpoint adjustment. Provide manufacturer's standard blank cover.

Each controller shall be labeled with the panel and circuit number of the 120 volt circuit supplying the device.

3.1.3.2 Low Temperature Protection Temperature Switch

For each 40 square feet of coil-face area, provide a temperature switch to sense the temperature at the location shown. Provide temperature switch sensing element in a serpentine pattern.

3.1.4 Pressure Sensors

3.1.4.1 Differential Pressure

General: Install pressure sensing tips in locations to sense appropriate pressure conditions.

3.1.5 Control Drawings

Provide 1 set of as-built drawings after installation is complete. The drawings shall also be copied onto double-sided, 1.44 MB capacity, 3.5-inch diskettes and submitted to the Contracting Officer.

3.2 ADJUSTMENTS

Calibrate instrumentation and controls and verify the specified accuracy using test equipment with a test equipment accuracy. Adjust controls and equipment to maintain conditions indicated, to perform functions indicated, and to operate in the sequence specified.

3.3 TRAINING

Provide 3 copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the DDC system supplied. The Contractor shall instruct the Government's designated representatives in these procedures during the startup and test period. The duration of the instruction period shall be no less than four, 4-hour sessions during normal working hours.

3.4 CALIBRATION AND ADJUSTMENTS

After completion of the installation, perform final calibrations and adjustments of the equipment provided under this contract and supply services incidental to the proper performance of the DDC system.

3.5 ACCEPTANCE PROCEDURE

An acceptance test shall be performed and witnessed by the Contracting Officer demonstrating that duct smoke detectors meet all functional criteria specified in NFPA 90A and NFPA 72 in addition to controls relating to fan shutdown and occupant notification.

Upon completion of the calibration, Contractor shall startup the system and perform all necessary testing and run diagnostic tests to ensure proper operation. Contractor shall be responsible for generating all software and entering all database necessary to perform the sequence of control and specified software routines.

3.6 COMMISSIONING PROCEDURE

The Contractor shall furnish all personnel and materials necessary for final systems checkout. The Contracting Officer's representative shall be present to observe and verify the commissioning procedure.

The Contractor shall demonstrate operation of the following system capabilities and components in the presence of the Contracting Officer's representative:

Provide a spreadsheet of the listing of all I/O points. The listing

shall include the project name as its title and the date. The point definition shall include the description, location, signal type and purpose (control or monitor) of each point.

Verify correct readings and operation of all physical analog I/O points by comparing actual parameter to remove indication as displayed by the system. All output points shall be exercised and checked for proper operation over its full range of operation and observing for correct response at the controlled equipment.

Exercise all physical digital I/O points for proper operation. All input points shall be checked with an ohmmeter for continuity and output points shall be checked for a dynamic response of the electromechanical device.

Verify the algorithms are operating as described in the "Sequence of Operations" portion of the specifications.

Verify auxiliary relays are properly identified with labels, as to their purpose.

Verify all room temperature sensors are labeled with the proper address of the controller which it is connected.

3.7 SEQUENCE OF OPERATION

The sequence of control shall be as indicated on drawings.

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SECTION 16003

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SECTION 16003

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(2000) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

FEDERAL SPECIFICATIONS (FS)

FS W-J-800	(Rev F) Junction Box: Extension, Junction Box; Cover, Junction Box (Steel, Cadmium, or Zinc-Coated)

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code

MILITARY SPECIFICATIONS (MS)

MS MIL-T-704	(Rev K) Treatment and Painting of Material

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA Z 535	(1991) Safety Color Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL-05	(1997) Electrical Construction Materials Directory

1.2 SUBMITTALS (Not Applicable)

1.3 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

It is the intent of these specifications and the contract drawings to provide a complete and workable facility.

Design drawings are diagrammatic and do not show all offsets, bends, elbows, or other specific elements that may be required for proper installation of the work. Such work shall be verified at the site. Additional bends and offsets, and conduit as required by vertical and horizontal equipment locations or other job conditions, shall be provided to complete the work at no additional cost to the Government.

Except where shown in dimensional detail, the locations of switches, receptacles, lights, motors, outlets, and other equipment shown on plans are approximate. Such items shall be placed to eliminate interference with ducts, piping, and equipment. Exact locations shall be determined in the field. Door swings shall be verified to ensure that light switches are properly located.

Equipment sizes indicated are minimum. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements and shall install wire, conduit, disconnect switches, motor starters, heaters, circuit breakers, and other items of the correct size for the equipment actually installed. Wire and conduit sizes shown on the drawings shall be taken as a minimum and shall not be reduced without written approval.

1.4 CODES AND STANDARDS

Equipment design, fabrication, testing, performance, and installation shall, unless shown or specified otherwise, comply with the applicable requirements of NFPA 70 and IEEE C2 to the extent indicated by the references.

1.5 COORDINATION

Installation of the electrical work shall be coordinated with the work of other trades.

1.6 APPROVAL REQUIREMENTS

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories (UL), Inc., the label of, or listing with re-examination, in UL-05 will be acceptable as sufficient evidence that the items conform to the requirements.

Where materials or equipment are specified to be constructed or tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized standards, a manufacturer's certificate of compliance indicating complete compliance of each item with the applicable NEMA, ANSI, ASTM, or other commercial standards specified will be acceptable as proof of compliance.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given a rust-inhibiting treatment and the standard finish by the manufacturer. Aluminum shall not be used in contact with earth. Dissimilar metals in contact shall be protected by approved fittings, barrier material, and treatment. Ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123 for exterior locations and cadmium-plated in conformance with FS W-J-800 for interior locations.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

Identification plates shall be 3-layer black-white-black, engraved to show white letters on a black background. Letters shall be uppercase. Identification plates 1-1/2 inches high and smaller shall be 1/16-inch thick with engraved lettering 1/8-inch high. Identification plates larger than 1-1/2 inches high shall be 1/8-inch thick with engraved lettering not less than 3/16-inch high. Identification plates having edges of 1-1/2 inches high and larger shall be beveled.

In addition to standard manufacturer's identification plates, engraved laminated phenolic identification plates shall be provided for each panelboard, transformer, disconnect switch, starters, and other electrical equipment shown on the contract drawings. Identification plates shall designate the function and rating of the equipment, unit number and electrical circuit feeder source.

Examples: **PANEL P-2500**
480/277 Volt, 3 Ph., 4 W, 60Hz
Fed from Brkr C5 Unit Substation Switchgear C

PANEL L-2600
208/120 Volt, 3 Ph., 4 W, 60Hz
Fed from P-2500 Brkr 15 via 112.5 kVA XFMR

PANEL L-2600
208/120 Volt, 3 Ph., 4 W, 60Hz
Fed from L-2600 Brkr 139"

2.2 WARNING SIGNS

Each item of electrical equipment operating at 480 volts and above shall be provided with conspicuously located warning signs conforming to the requirements of Occupational Safety and Health Agency (OSHA) standards.

Any equipment with externally powered wiring shall be marked with a laminated plastic nameplate having 3/16-inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Safety color coding for identification of warning signs shall conform to NEMA Z 535.

2.3 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or slabs.

2.4 PAINTING

Enclosures of the following listed items shall be cleaned, primed, and factory-painted inside and outside in accordance with MS MIL-T-704.

ITEM	FINISH COLOR
Transformers	No. 61 gray (FED-STD 595)

ITEM	FINISH COLOR
Safety Switches	Manufacturer's standard
Panelboards	Manufacturer's standard
Motors	Manufacturer's standard
Limit Switches	Manufacturer's standard
Control Components	Manufacturer's standard

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations.

3.2 PAINTING APPLICATION

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks, if not factory painted, shall be thoroughly cleaned and painted as specified in Section 09920, "Architectural Painting," unless otherwise noted. Work shall be left in a neat and clean condition at final completion of the contract.

Emergency equipment, such as fire-alarm boxes, shall be cleaned, primed, and painted red. Color shall conform to FED-STD 595, Color 11105.

3.3 IDENTIFICATION PLATE INSTALLATION

Identification plates shall be fastened by means of corrosion-resistant steel or nonferrous metal screws. Hand lettering, marking, or embossed self-adhesive tapes are not acceptable.

3.4 CUTTING AND PATCHING

Contractor shall install the work in such a manner and at such time as will require a minimum of cutting and patching on the building structure.

Holes in or through existing masonry walls and floors in exposed locations shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

3.5 DAMAGE TO WORK

Required repairs and replacement of damaged work shall be done as directed by and subject to the approval of the Contracting Officer, and at no additional cost to the Government.

3.6 CLEANING

Exposed surfaces of wireways, conduit systems, and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish or painting or are enclosed within the building structure.

Before final acceptance, electrical equipment, including lighting fixtures

and glass, shall be clean and free from dirt, grease, and fingermarks.

3.7 FIELD TESTING AND TEST EQUIPMENT

All Field testing specified in Divisions 16 electrical specification shall be made with test equipment specially designed and calibrated for the purpose. Test equipment used shall be calibrated and certified by the Contracting Officer approved testing laboratory. Date of last calibration and certification shall not be more than 90 days old at the time of field testing.

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SECTION 16065

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SECTION 16065

SECONDARY GROUNDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 3	(1995) Standard Specification for Soft or Annealed Copper Wire

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

MILITARY STANDARDS (MIL-STD)

MIL-STD 889	(Rev B, Notice 2) Dissimilar Metals

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467	(1993; 7th Ed) UL Standard for Safety Grounding and Bonding Equipment

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Grounding Rods
Ground Wires
Connectors and Fasteners

SD-04 Drawings

As-Built Drawings shall indicate the location of ground rods, mats, grids, building ground bus, supplementary grounding electrodes, steel building columns, and other metal structures connected to the grounding system.

Location of each ground rod and ground-rod assembly and other grounding electrodes shall be identified by letter in alphabetical order and keyed to the record of ground-resistance tests.

SD-09 Reports

Test Reports shall be submitted for the following field tests on grounding systems in accordance with the paragraph entitled, "Field Tests," of this section.

Bond Resistance Tests
Grounding Resistance Tests
Continuity Isolation Tests

PART 2 PRODUCTS

2.1 GROUND RODS

Ground rods shall conform to the requirements of NFPA 70 and UL 467.

Ground rods shall be copper-clad steel rods not less than 3/4 inch in diameter and not less than 10-feet long per section. Ground rods shall be clean and smooth and have a cone-shaped point on the first section and shall be die-stamped near the top with the name or trademark of the manufacturer and the length of the rod in feet.

2.2 GROUND WIRES

Ground wires shall be in accordance with Section 16145, "Standard Wiring Systems."

Ground and bond wires for transformers, main panels and distribution points, and ground rod connections shall be annealed bare copper conforming to ASTM B 3, stranded, with 98 percent conductivity. Wire size shall be in accordance with the grounding requirements of NFPA 70.

Ground wires for equipment receptacles for noncurrent carrying hardware, installed in conduit shall be soft drawn copper, in accordance with ASTM B 3, stranded, with green insulation. Wire size shall be as noted.

2.3 CONNECTORS AND FASTENERS

Grounding and bonding fasteners and connectors shall conform to the requirements of UL 467, and Section 16145, "Standard Wiring Systems."

Grounding and bonding fasteners shall be copper.

Bonding straps and jumpers shall be copper and shall have a cross-sectional area of not less than No. 6 AWG. Bonding straps and jumpers for shock-mounted devices with swivel joints shall be made of woven-wire braid.

PART 3 EXECUTION

3.1 BONDING AND GROUNDING

Bonding and grounding requirements shall be in accordance with NFPA 70.

3.2 GROUNDING ELECTRODES

Grounding electrodes shall include ground rods installed expressly for grounding systems.

Minimum ground rod section shall be 10 feet.

Ground rods shall be installed so that the top of the rod is not less than 18 inches below finished grade.

3.3 EQUIPMENT GROUNDING

Metallic raceway systems shall have electrical continuity with equipment individually and directly connected to the building ground, independent of the raceway system.

Enclosures for panelboards and transforers shall be individually and directly connected to the building ground. Grounding conductor shall be not less than No. 2 AWG and shall be connected from the building ground to a copper ground-bus terminal strip located in each panelboard.

Polarized receptacles, lighting fixtures, and equipment enclosures shall be grounded with an identified (green color) insulated conductor, not smaller than No. 12 AWG, connected to the branch circuit ground-bus terminal strip. Ground-bus terminal strip in each panelboard enclosure shall be isolated and independent of the system neutral terminal strip.

Noncurrent carrying metallic parts of electrical equipment, including metallic cable sheaths, conduit, raceways, and electrical structural members, shall be bonded together and connected to the ground grid or ground connection rods.

3.4 GROUNDING CONNECTIONS

Ground connections shall be bonded connections in accordance with paragraph entitled, "Bonding."

Ground connections that are buried or in inaccessible locations shall be welded.

Connections in accessible locations shall be bolted. Connections to steel building columns in accessible locations shall be cast-copper-alloy clamp lugs bolted to the structure.

Ground connection surfaces shall be cleaned, de-greased and foreign matter removed. Clad material shall not be penetrated in the cleaning process. Connection shall be made between like metals where possible. Where dissimilar metals are welded, brazed, or clamped, the weld kit manufacturer's instructions shall be followed. Connections between dissimilar metals shall not produce galvanic action in accordance with MIL-STD 889.

3.5 BONDING

3.5.1 Type of Bonds

Bonding of metal surfaces shall be accomplished by welding, unless otherwise noted.

3.5.1.1 Welding

Welding shall be by the exothermic process. Welding procedure shall include the proper mold and powder charge and shall conform to the manufacturer's recommendations.

Welding processes shall be of the exothermic fusion type that will make a connection without corroding or loosening. Process shall join all strands and shall not cause the parts to be damaged or weakened. Completed connection or joint shall be equal or larger in size than the conductors joined and shall have the same current-carrying capacity as the largest conductor. Buried ground connections shall be painted with a bitumastic paint.

3.5.2 Cleaning of Bonding Surfaces

Surfaces that comprise the bond shall be thoroughly cleaned before joining. An appropriate abrasive shall be applied with a gentle and uniform pressure to ensure a smooth and uniform surface. Excessive metal shall not be removed from the surface. Clad metals shall be cleaned in such a manner that the cladding material is not penetrated by the cleaning process. Bare metal shall then be cleaned with an appropriate solvent to remove any grease, oil, dirt, corrosion preventives, and other contaminants. Cleaned area shall be made within one hour after cleaning. Joint shall be sealed and the exposed surfaces refinished within two hours to prevent oxidation. When additional time is required, a corrosion preventive compound shall be applied until the area can be refinished.

3.5.3 Bonding Straps and Jumpers

Jumpers shall be installed such that the vibration by the shock-mounted device shall not change its electrical characteristics.

Bonds shall be brazed for outdoor locations unless a disconnect type of connection is required. When a disconnect is required, clamping with bolts shall be used. A tooth-type lockwasher shall be inserted between the strap and metallic member for each bolt.

Straps shall be bonded directly to the basic structure and shall not penetrate any adjacent parts. Straps shall be installed in an area that is accessible for maintenance.

Single straps shall be used for the bonds and shall be installed such that they will not restrict movement of structural members. Two or more straps shall not be connected in series.

Straps shall be installed such that they will not weaken structural members to which they are attached.

3.5.4 Equipment and Enclosure Bonding

Each metallic enclosure and all electrical equipment shall be bonded to

ground. At least one copper connection shall be made from the system ground point to one or more enclosures in the area such that all enclosures and equipment provide a low-impedance path to ground when properly bonded together.

3.5.5 Bonding of Conduit and Raceway Systems

Metal conduit, fittings, junction boxes, outlet boxes, armored and metal sheathed cable, and other raceways shall be bonded as listed below. Care shall be taken to ensure adequate electrical contact at the joints and terminations.

3.5.5.1 Rigid Metal Conduit and Terminations

Threaded connections must be wrench-tight and there shall be no exposed threads. All ends of the conduit shall be reamed to remove burrs and rough edges. Conduits entering boxes and enclosures shall be bonded to the box with locknuts and grounding-type bushings. Locknuts that gouge into the metal box when tightened are not acceptable.

Conduit systems that are interrupted by PVC dielectric links shall be bonded separately on either side of the link. Dielectric link shall not be jumpered.

3.5.5.2 Flexible Metal Conduit

Flexible conduit shall have an integral grounding conductor.

3.5.6 Protection of Finished Bonds

Finished bonds shall be protected by painting to match the original finish after the bond is made.

3.6 FIELD TESTS

The following tests shall be performed by the Contractor in the presence of the Contracting Officer.

3.6.1 Bond Resistance

Resistance of any bond connection shall not exceed 0.5 milliohm. Bonds that exceed this resistance shall be reworked by the Contractor at no additional cost to the Government.

3.6.2 Grounding Resistance Tests

Grounding systems shall be tested for ground resistance. Total resistance from any point on the ground network to the building counterpoise shall not exceed 25 milliohms.

Ground resistance tests shall be made during dry weather, and no sooner than 48 hours after rainfall. Measurements shall be performed in accordance with IEEE Std 81.

3.6.3 Ground Isolation Test

Ground systems shall be tested for isolation from other ground systems.

3.6.4 Continuity Isolation Test

Continuity test shall be performed on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

-- End of Section --

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SECTION 16145

STANDARD WIRING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI C80.3	(1994) Electrical Metallic Tubing - Zinc-Coated

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(2000) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM D 2301	(1988; R 1993) Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA FB 1	(1993) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA KS 1	(1996) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA PR 4	(1983; R 1989) Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type for Industrial Use
NEMA WD 1	(1983; R 1989) General Requirements for Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(1993) UL Standard for Safety - Flexible Metal Conduit

UL 1581	(1997; 3rd Ed) UL Standard for Safety - Reference Standard for Electrical Wires, Cables, and Flexible Cords
UL 20	(1995) UL Standard for Safety General-Use Snap Switches
UL 486C	(1997; 3rd Ed) UL Standard for Safety Splicing Wire Connectors
UL 50	(1995; 11th Ed) UL Standard for Safety - Enclosures for Electrical Equipment
UL 514A	(1996; 9th Ed) UL Standard for Safety - Metallic Outlet Boxes
UL 514B	(1996; 3rd Ed) UL Standard for Safety Fittings for Conduit and Outlet Boxes
UL 6	(2000) UL Standard for Safety - Rigid Metal Conduit
UL 797	(1993; 6th Ed) UL Standard for Safety - Electrical Metallic Tubing

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Wire and Cable
Safety Switches
Wiring Devices
Communication Cabinets

SD-09 Reports

Test Reports shall be submitted for Standard Wiring Systems in accordance with the paragraph entitled, "Field Testing," of this section.

PART 2 PRODUCTS

2.1 CONDUITS, RACEWAYS, AND FITTINGS

Conduit shall be 3/4-inch diameter minimum, except where specifically shown smaller on the contract drawings, and except for exposed switch leg runs.

Conduit, connectors, and fittings shall be approved for the installation of electrical conductors.

2.1.1 Rigid Steel Conduit

Rigid steel conduit, including couplings, elbows, bends, and nipples, shall conform to the requirements of UL 6 and ANSI C80.1. Steel fittings shall be galvanized by the hot-dip process.

Fittings for rigid steel conduit shall be threaded and shall conform to NEMA FB 1.

Gaskets shall be solid for fittings sized 1-1/2 inches and less. Conduit fittings with blank covers shall have gaskets except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and shall be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be rigid metallic conduit of the thinwall type in straight lengths, elbows, or bends and shall conform to ANSI C80.3 and the requirements of UL 797.

Couplings and connectors shall be hex-nut expansion-gland type, zinc or cadmium-plated. Crimp, spring, or setscrew type fittings are not acceptable. Where EMT enters outlet boxes, cabinets, or other enclosures, connectors shall be the insulated-throat type, with a locknut. Fittings shall meet the requirements of NEMA FB 1.

2.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall meet the requirements of UL 1.

Liquid tight flexible metallic conduit shall be provided with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Fittings for flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Type III coupling, electrical conduit, flexible steel, or Type IV adapter, electrical conduit.

Fittings for liquid tight flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Class 3 liquid tight flexible metallic conduit connectors.

2.2 WIRE AND CABLE

Insulated current-carrying wire and grounding conductors shall be copper and shall conform to NFPA 70 and UL 1581. Wire bundles with cable ties shall be secured to the enclosure with sheet-metal screws. Self-sticking adhesive attachments are not acceptable.

2.2.1 Building Wire

Building wire for use in conduits, raceways, and wireways shall be single-conductor, 600-volt, heat- and moisture-resistant insulated wire

suitable for use in wet or dry locations.

Conductors AWG No. 10 and smaller shall be solid round copper wire. Conductors AWG No. 8 and larger shall be standard concentric stranded copper wire. Conductors shall be not less than AWG No. 12, except that AWG No. 14 shall be stranded copper wire and shall be used for control wiring.

Building wire shall be Type THHN with insulation of PVC and nylon jacket, with a minimum temperature rating of 90 degrees C.

2.2.2 Lighting-Fixture Wiring

Lighting-fixture wire for outlet-box connection to incandescent-fixture lampholders shall be flexible seven-strand copper wire with insulation conforming to NFPA 70.

Lighting-fixture wire for use in fluorescent fixture wiring channels shall be flexible seven-strand or solid copper wire conforming to NFPA 70.

2.2.3 Splices and Connectors

Splices in building wire AWG No. 8 and smaller and multiple conductor cables shall be made with insulated Scotchlock, or equal, connectors or with indentor crimp-type connectors and compression tools to ensure a satisfactory mechanical and electrical joint.

Splices in building wire AWG No. 6 and larger and single-conductor cables shall be made with indentor crimp-type connectors and compression tools or with bolted clamp-type connectors to ensure a satisfactory mechanical and electrical joint.

Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor. Splices in rubber-insulated neoprene-jacketed wire and cables shall be watertight.

Terminal lugs for 10-AWG and smaller conductors shall be of solderless, insulated, tool-crimped type.

Terminal lugs for 8-AWG and larger conductors shall be a heavy-duty cast high copper alloy and have a conductor clamping saddle secured by a brass or bronze hex-socket set screw. Lugs shall be of the Locktite Series for code copper conductors, as manufactured by Thomas and Betts Corporation, or equal.

Stranded wire shall use lugs for termination on terminal blocks.

2.3 SAFETY SWITCHES

Switches shall comply with NEMA KS 1.

Safety switches shall be the heavy-duty type with voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, with the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and shall be so constructed that an external tool (screwdriver) must be used to open the cover. Provisions shall be made to lock the handle in the "OFF" position, but the switch handle shall not be capable of being locked in the ON position.

Switches shall be the quick-make, quick-break type. Terminal lugs shall be approved by the manufacturer for use with copper conductors.

2.4 FLUSH WIRING DEVICES

2.4.1 Wall Switches

Snap switches installed for the control of incandescent, HID, and fluorescent lighting fixtures shall be heavy-duty, general-purpose, noninterchangeable flush devices conforming to UL 20 and NEMA WD 1, as indicated.

Snap switches shall be the toggle type: single-pole three-way and four-way two-position devices rated 20 amperes at 277 volts, 60 hertz, ac only, meeting the requirements of UL 20.

All snap switches shall be made by the same manufacturer.

Where two or more snap switches are to be installed at the same location, they shall be mounted in one-piece ganged switch boxes, with a gang cover plate.

2.4.2 Receptacles

Receptacles shall be 20-ampere, 125-volt ac, 2-pole, 3-wire, duplex grounded, conforming to NEMA PR 4, NEMA WD 1 and to the 5-20R configuration in NEMA WD 6.

Bodies of 20-ampere receptacles shall be heavy duty nylon compound supported by a mounting yoke having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Each receptacle shall be side and back-wired with two screws per terminal, shall be provided with a third grounding pole, and shall be capable of receiving 2-wire, 3-pole parallel-blade caps. Third grounding pole shall be connected to a metal mounting yoke and shall be provided with a green-colored screw for grounding.

Receptacles shall meet the requirements for retention of plugs, overload, temperature, and assembly security in accordance with NEMA WD 1.

2.4.3 Device Plates

Wall plates for flush snap switches and receptacles shall be the appropriate type and size and shall match the wiring devices for which they are intended. Dimensions for openings in wall plates shall be in accordance with NEMA WD 1.

Wall plates for flush snap switches and receptacles shall be corrosion-resistant steel not less than 0.040-inch thick, with beveled edges and a brushed satin finish. Mounting screws shall be corrosion-resistant steel with oval countersunk heads finished to match the plate.

2.5 BOXES AND FITTINGS

Boxes shall have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70 and UL 514A. Boxes that are exposed to the weather or that are in normally wet locations shall be cast-metal with threaded hubs. Surface-mounted boxes on interior

walls shall be cast-metal. Boxes in other areas shall be cadmium-plated or zinc-coated sheet metal.

2.5.1 Sheet Metal Boxes and Outlets

Outlet, switch, and junction boxes flush-mounted in walls or ceilings shall be square or rectangular-shaped gang boxes as appropriate, with extension rings and covers.

Ceiling outlet boxes, from which surface- and pendant-mounted lighting fixtures are supported, shall be not less than 4 inches square, with plaster rings 1-1/2 inches deep and shall be capable of withstanding a weight of 200 pounds for 5 minutes. All boxes in spaces above suspended ceilings shall be installed in accessible locations. Boxes in otherwise inaccessible locations shall be accessible from ceiling space access panels. Ceiling-mounted outlet boxes for lighting fixtures, fittings, and wiring devices shall be symmetrical, except as otherwise indicated, and shall not interfere with the work of other trades.

Wall outlet boxes for single and two-gang flush wiring devices shall be not less than 4 inches square and 1-1/2 inches deep. Wall outlet boxes for multiple-gang flush wiring devices shall be not less than 4-1/2 inches wide and 2-1/2 inches deep. Wall-mounted outlet boxes for lighting fixtures and flush devices shall be capable of withstanding a weight of 50 pounds for a period of 5 minutes.

Boxes shall be formed from carbon-steel sheets of commercial quality, not less than 14-gage. Boxes shall be one-piece construction, zinc- or cadmium-plated in accordance with UL 514A. Boxes and box extension rings shall be provided with knockouts. Boxes shall be designed for mounting flush wiring devices.

Exposed surface junction boxes shall be installed only in areas where walls are existing.

Surface-mounted boxes shall be outside flange type with a matching solid flat cover. Flush-mounted boxes in walls and floors shall be the outside flange type with a matching recessed solid walkway cover. Box bodies and covers shall be galvanized by the hot-dip process in accordance with ASTM A 123, Class A.

2.5.2 Pull and Junction Boxes

Pull and junction boxes shall be fabricated from carbon steel and shall conform to UL 50. Box dimensions and conduit connections shall conform to NFPA 70.

Boxes shall be welded construction with flat removable covers fastened to the box with machine screws. Seams and joints at corners or back edges of the box shall be closed and reinforced with flanges formed of the same material from which the box is constructed or by other means such as continuous welding which provides a construction equivalent to integral flange construction.

Boxes intended for outdoor use shall be cast aluminum, cast iron, or hot-dipped galvanized with threaded hubs and neoprene-gasketed covers.

Boxes intended for use in dry locations shall be sheet steel galvanized after fabrication conforming to UL 514A.

2.6 COMMUNICATION CABINETS

Cabinets shall conform to UL 50.

Cabinets for signal systems shall have boxes constructed of code-gage, zinc-coated sheet steel with interior dimensions not less than those indicated. Each box shall be fitted with a screw type cover. Boxes shall be provided with a back panel.

Cabinets for electrical controls with volume greater than 100 cubic inches shall be hot-dip galvanized, aluminum, or code-gage sheet steel with corrosion-resistant baked enamel finish.

PART 3 EXECUTION

3.1 INSTALLATION

Power, lighting, control, emergency light and power, and special-service systems and all related components shall be installed in accordance with NFPA 70, and shall be enclosed in separate conduit or separate conduit systems.

Any run of electric metallic tubing (EMT) or rigid conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain not more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting. Installed conduit and fittings shall be free of dirt and trash and shall not be deformed or crushed. Empty conduit shall have a pull wire installed.

Conduit shall be installed with a minimum of 3 inches of free air space separation from mechanical piping.

Conduit in finished areas shall be installed concealed. Conduit passing through masonry or concrete walls shall be installed in sleeves. The space between conduit and sleeve shall be sealed with fire rated sealant on both sides of wall.

Conduit shall be securely clamped and supported at least every 10 feet vertically and 8 feet horizontally. Galvanized pipe straps shall be fastened to structure with bolts, screws, and anchors. Wooden masonry plugs shall not be used.

Conduit and boxes shall not be supported from T-bar ceiling wires.

All recessed outlet boxes in non-combustible walls or ceilings shall be installed flush, such that the outlet box is set back less than 1/16-inch or protrudes less than 1/16 inch from the face of the ceiling or wall.

In addition to the provisions of Article 370-10 of the National Electrical Code which requires recessed outlet boxes in combustible walls or ceilings to be installed flush with the surface, all recessed outlet boxes in non-combustible walls or ceilings shall be installed flush with the surface. The definition of "flush" in this paragraph means the outlet box is set back less than 1/16 inch or protrudes less than 1/16 inch from the face of the wall or ceiling.

Conduit connections to boxes and fittings shall be supported not more than 36 inches from the connection point. Conduit bends shall be supported not

more than 36 inches from each change in direction. Conduit shall be installed in neat symmetrical lines parallel to the centerlines of the building construction and the building outline. Multiple runs shall be parallel and grouped whenever possible on common supports.

Conduit and raceway runs in corrosive, or outdoor locations, shall be rigid steel conduit. Conduit joints in corrosive areas shall be painted with corrosion-inhibiting compounds.

Bushings shall be provided on the open ends of conduit containing conductors. Insulated bushings shall be provided for conduits containing conductors AWG No. 4 or larger with an insulating ring an integral part of the bushing.

Flexible metallic conduit shall be used to connect recessed fixtures from outlet boxes in ceilings, metallic transformers, and other approved assemblies. Sections of flexible steel conduit shall be not more than 6 feet long and shall be installed only in exposed or accessible locations. Interior surfaces of conduit shall be free from burrs and sharp edges which might cause abrasion of wire and cable coverings. Ends of flexible steel conduit shall be provided with grounding bushings and approved fittings.

Flexible conduit shall not be considered a ground conductor.

Liquidtight flexible metallic conduits shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit in a manner that will not impair the function of the equipment.

Wire or cable shall not be installed in conduit until the conduit system is completed; the inner surfaces of conduit shall be clean and dry.

A nylon or polypropylene pull rope with a tensile strength not less than 130 pounds or No. 14 AWG galvanized pull wire shall be installed in empty conduit.

3.1.1 Installation of Rigid Metal Conduit

Ends of conduit shall be cut square, reamed and threaded, and joints shall be brought butt-to-butt in the couplings. Joints shall be mechanically tight. Conduit shall be protected against damage and the entrance of water or foreign material during construction.

Ninety-degree bends of conduit with a diameter larger than 1 inch shall be made with factory-made elbows. Conduit elbows larger than 2-1/2 inches shall be long radius. Field-made bends and offsets shall be made with a hickey or conduit-bending machine. Changes in directions of runs shall be made with symmetrical bends or cast-metal fittings.

At connections to sheet metal enclosures and boxes, a sufficient number of threads shall project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be pulled up sufficiently tight to draw the bushing into firm electrical contact with the box. Conduit shall be fastened to sheet metal boxes and cabinets with two locknuts where required by NFPA 70 where insulating bushings are used, where bushings cannot be brought into firm contact with the box, and where indicated.

Conduit joints shall be made with tapered threads set firmly. Each length of conduit cut in the field shall be reamed before installation. Where conduit is threaded in the field, each threaded end shall consist of at least five full threads. Corrosion-inhibitive compound shall be used on conduit threads in exterior areas.

3.1.2 Installation of EMT

EMT shall be cut square and reamed to remove burrs and rough surfaces.

Field-made bends and offsets shall be avoided where possible but, where necessary, shall be made with an approved hickey or conduit-bending machine. Changes in direction of runs shall be made with symmetrical bends or approved metal fittings.

3.1.3 Installation of Flexible Metallic Conduit

Flexible metallic conduit shall be installed only in exposed, accessible locations in accordance with NFPA 70. A grounding green conductor shall be installed in all runs. Connections to motors and vibrating equipment shall be made with flexible metallic conduit.

3.2 INSTALLATION OF WIRING

Raceways shall be completely installed, with interiors protected from the weather, before proceeding with the installation of wires and cables. Conductors of special-service systems and emergency light and power systems shall not occupy the same enclosure with light and power conductors or the same enclosure with each other. Conductors shall be continuous with splices and connections made in outlet, junction, or pull boxes only. All control wiring shall be continuous between components and/or terminal boards.

Phase conductors and the neutral conductor of each branch or feeder circuit shall be contained in a single enclosure or paralleled in separate enclosures to avoid overheating the raceway by electromagnetic induction. Conductors and conduit in parallel shall be the same length and size, shall have conductors of the same type of insulation, shall be terminated at both ends in a manner to ensure equal division of the total current among conductors, and shall have a separate neutral conductor in each conduit.

Sharing of a common neutral between single phase circuits, connected to different phases, shall not be permitted. Each single phase circuit shall have a unique individual neutral conductor.

Conductors shall have allowable current-carrying capacity and ampere ratings in accordance with NFPA 70. Larger-sized conductors shall be used to compensate for derating factors when more than three current-carrying conductors are installed in raceways and when conductors are installed in wet locations.

Conductors 600 volts and below shall be color coded in accordance with the following:

CONDUCTOR	120/208 COLOR	480/277 COLOR
Phase A	Black	Brown

CONDUCTOR	120/208 COLOR	480/277 COLOR
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	White/Gray
Equipment Grounds	Green	Green

Conductors for fire alarm system shall be color coded as specified in Section 13852, "Fire Alarm Systems".

Conductors up to and including AWG No. 10 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 10 shall have ends identified with colored plastic tape in outlet, pull, or junction boxes. Control circuit conductors shall be identified at each connection point.

Connectors and splices shall conform to UL 486C and shall be made in approved enclosures utilizing solderless pressure connectors and adequate insulation with vinyl-plastic electrical insulating tape. Conductors and materials used in a splice, tap, or connection shall be thoroughly cleaned prior to makeup to ensure good electrical and mechanical connections. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable. Control-circuit terminals of equipment shall be properly identified by color-coded insulated conductors, number-coded plastic self-sticking printed markers, or permanently attached metal-foil markers. Cable fittings shall conform to UL 514B; insulating tape shall conform to ASTM D 2301.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

Grounding shall be provided in accordance with NFPA 70.

3.3 SAFETY SWITCHES

Switches shall be securely fastened to the supporting structure or wall utilizing a minimum of four 1/4-inch bolts. Sheet metal screws and small machine screws shall not be used for mounting. Switches shall not be mounted in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible.

3.4 WIRING DEVICES

3.4.1 Wall Switches and Receptacles

Wall switches and receptacles shall be installed so that when device plates are applied, the plates will be aligned vertically to within 1/16 inch.

Ground terminal of each flush-mounted receptacle shall be bonded to the

outlet box with an approved green bonding jumper.

3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 20-ampere, 125-volt, single-phase, duplex, convenience outlets shall be suitably engraved, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle; for example: RP1-12, 208 VOLTS, 60 HERTZ, 3-PHASE, 30 AMPERES. If engraving is not practical, an engraved laminated phenolic identification plate may be applied.

Device plates shall be identified on the inside by circuit number and panelboard.

3.5 BOXES AND FITTINGS

Pullboxes shall be furnished and installed where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Boxes and enclosures shall be securely mounted to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Bonding jumpers shall be used around concentric or eccentric knockouts.

Approximate mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be as follows:

LOCATION	MOUNTING HEIGHT
Receptacles in offices, control room	18 inches
Receptacles in shop	48 inches
Switches for light control	48 inches
Thermostats	66 inches

3.6 IDENTIFICATION PLATES

Red identification plates reading CAUTION: 480/277 VOLTS shall be provided in switch and outlet boxes containing 277- or 480-volt circuits. An identification plate marked DANGER: 480 VOLTS shall be provided on the outside of 480-volt enclosures. Identification plate shall use white lettering on a red laminated plastic.

Any equipment with externally powered wiring shall be marked with a laminated plaster nameplate having 3/16-inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

3.7 FIELD TESTING

After completion of the installation and splicing, and prior to energizing the conductors, wire and cable shall be given continuity and insulation tests as herein specified before the conductors are energized.

Necessary test equipment, labor, and personnel shall be provided by the Contractor to perform the tests, as herein specified. Continuity tests shall be conducted using a dc device with bell or buzzer.

Wire and cable in each voltage classification shall be completely isolated from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Insulation tests on circuits rated 480-volts and less shall be conducted using a 1000-volt insulation-resistance test set. Readings shall be taken every minute until three equal and consecutive readings are obtained. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Insulation tests on circuits rated 240 volts or less, with conductor sizes 2 AWG and larger, shall be conducted using a 500-volt insulation-resistance test set. Readings shall be taken after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Phase-rotation tests shall be conducted on all three-phase circuits using a phase-rotation indicating instrument. Phase rotation of electrical connections to connected equipment shall be clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. No conductor shall be energized until the installation is approved.

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SECTION 16225

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SECTION 16225

MOTORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 112	(1991) Standard Test Procedure for Polyphase Induction Motors and Generators

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Equipment and Performance Data shall be submitted for Motors consisting of use life, system functional flows, safety features, and mechanical automated details. Curves indicating tested and certified equipment response and performance characteristics shall also be submitted.

Manufacturer's Catalog Data shall be submitted for the following items:

Motors
Enclosures

SD-13 Certificates

Certificates of Compliance shall be submitted for the following tests showing conformance with the referenced standards contained in this section. Certified copies of previous test reports on identical motors may be submitted in lieu of factory test reports.

Efficiency
Power-Factor
Service Factor
Temperature Rise

Noise

PART 2 PRODUCTS

2.1 EQUIPMENT

Design, fabrication, testing, and performance of motors shall be in accordance with NEMA MG 1.

Testing and performance of polyphase induction motors shall be in accordance with IEEE Std 112, Method B.

Efficiency labeling shall be in accordance with NEMA MG 1.

2.2 MOTOR TYPES

Induction motors with 5- to 250-horsepower (HP) rating shall be the energy-efficient type and efficiencies shall be as high as those shown below. Motor shall be marked to show the index letter, which shall be the letter shown or a letter that indicates a higher efficiency.

Energy Efficiency Chart

HP	RPM	NOMINAL EFFICIENCY
5 and larger	1,800	88.5

Motors shall be of the following types:

1/3 HP and smaller, single phase - capacitor start

1/2 HP and larger, three-phase - induction squirrel-cage type, NEMA Design B, having normal starting torque and low starting current

Motors shall be designed for across-the-line starting and shall be designed with torque characteristics to carry the specified rated starting load.

Motors shall have factory-sealed ball bearings.

2.3 SIZES OF MOTORS

2.3.1 Motors

Motors shall be a sufficient size for the duty to be performed and shall not exceed the full-load rating when the driven equipment is operating at specified capacity under the most severe loading conditions.

2.3.2 Electrically Driven Equipment

When electrically driven equipment differs from that indicated, adjustments shall be made to the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed, at no additional cost to the Government. Control and protective devices shall be in accordance with Section 16286, "Overcurrent Protective Devices."

2.4 VOLTAGE RATINGS

Motors shall have the following minimum voltage ratings:

MOTOR SIZE			MOTOR
MOTOR TYPE	HORSEPOWER	SERVICE	VOLTAGE RATING
Fractional horsepower, single-phase	1/3 and smaller	120/208-volt, 3-phase, 4-wire	115-volt, 60-hertz
Fractional and integral horsepower, 3-phase	1/2 and larger	480-volt, 3-phase, 3-wire	230/460-volt, 3-phase, 60-hertz

2.5 TEMPERATURE RATING AND INSULATION

Motors shall be designed for continuous operation at the rated full load in an ambient temperature of 104 degrees F.

Insulation level shall be at least Class B.

2.6 MOTOR ENCLOSURES

Motors installed in indoor, clean, dry, nonhazardous locations shall have open-type drip-proof enclosures.

Motors installed in indoor, nonhazardous locations where it is necessary to protect the motor from dirt, moisture, chemical fumes, or other harmful ingredients in the surrounding atmosphere shall be the totally enclosed type, with either of the following:

Totally enclosed, not fan-cooled, enclosures not equipped for cooling by means external to the enclosing parts.

Motors installed in outdoor, nonhazardous locations shall have waterproof enclosures.

2.7 SERVICE FACTOR

Service factor of general purpose and other open ac motors shall be in accordance with NEMA MG 1.

Totally enclosed ac motors shall have a service factor of 1.15.

2.8 FACTORY TESTS

Motors shall be factory-tested in accordance with the requirements of NEMA MG 1. Polyphase induction motors shall be factory-tested in accordance with IEEE Std 112, Method B. Tests shall consist of routine testing, including measurements of voltage, frequency, speed, and current under no-load conditions; voltage, frequency, and current under locked-rotor conditions; and efficiency, noise, power factor, and thermal protection. Routine tests on wound-rotor induction motors shall include the measurement of wound-rotor open-circuit voltage across the slip rings under locked-rotor conditions. Routine tests on all motors shall include high-potential tests.

PART 3 EXECUTION

3.1 INSTALLATION

Motors shall be installed, aligned, and connected in accordance with the equipment manufacturer's instructions.

Alignment of motors shall be rechecked and adjusted as required after the motor has been in operation for not less than 48 hours.

3.2 SITE TESTING

Motors on motor-driven equipment shall be given continuity and insulation tests after the installation is completed and before the equipment is energized. Motors shall be inspected for damage, moisture, alignment, proper lubrication, oil leaks, phase identification, and cleanliness before conducting tests. Motors shall be completely isolated from the source of supply before conducting the tests.

Test equipment, labor, and personnel shall be provided to perform the tests required. Continuity tests shall be conducted when indicated.

Insulation tests:

Insulation tests on 480-volt motors shall be conducted using a 1000-volt insulation-resistance test set. Readings shall be recorded every minute until three equal and consecutive readings are obtained. The resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Insulation tests on motors 300 volts or less shall be conducted using a 500-volt minimum insulation-testing instrument. Readings shall be recorded after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Test data shall be recorded and shall include the location and identification of motors and megohm readings versus time.

After the installation has been thoroughly tested and found to be in satisfactory condition, with thermal overload relays in motor controllers properly rated and in place, authorization shall be obtained from the Contracting Officer prior to energizing the equipment at the system voltage for final operational tests.

Duration of final operational tests to prove satisfactory performance will be determined by the Contracting Officer.

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SECTION 16275

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SECTION 16275

TRANSFORMERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA ST 1	(1988) Specialty Transformers (Except General Purpose Type)

UNDERWRITERS LABORATORIES (UL)

UL 506	(2000) UL Standard for Safety Specialty Transformers

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Equipment and Performance Data shall be submitted for Distribution Transformers including resistance measurements, impedance, and voltage and load losses at rated currents.

Manufacturer's Catalog Data shall be submitted for the following items:

Distribution Transformers
Paint Materials

SD-04 Drawings

Connection Diagrams shall be submitted for Distribution Transformers indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system or portion of system with another, and internal tubing, wiring, and other devices.

SD-09 Reports

Test Reports shall be submitted for the following tests on distribution transformers in accordance with the paragraph

entitled, "Field Testing," of this section.

Insulation Resistance Tests

SD-13 Certificates

Certificates of Compliance of previous tests on similar units under actual conditions may be submitted for impulse tests, temperature-rise tests, sound tests, power-factory tests, bushing tests, and short-circuit tests in lieu of factory tests on actual units furnished.

1.4 QUALIFICATION TESTING

Tests on transformers shall comprise the manufacturer's standard tests including resistance measurements of all windings; ratio tests; polarity and phase-relation tests; no-load loss at rated voltage; impedance; voltage and load loss at rated current and dielectric tests.

PART 2 PRODUCTS

2.1 EQUIPMENT STANDARDS

2.1.1 Dry-Type Distribution Transformers

Dry-type transformers for connection to low-voltage distribution circuits of 600 volts or less and the supply of current for lighting and power loads shall be two-winding, copper, 60-hertz, self-contained, self-cooled, Class AA for outdoor NEMA 3R installation in accordance with NEMA ST 1 and UL 506.

Transformer winding and connection lugs shall be of copper. There shall be six full capacity taps. Two shall be 2-1/2 pecent above and four shall be 2-1/2 below nominal rating.

Insulation system limiting temperature shall be in accordance with the following table, with a temperature rise of:

Dry-Type Class	Maximum Rise by Resistance	Reference Temperature
B	80 degrees C	110 degrees C

Transformers shall be 112.5 and 45 kVA filtered, electrostatically shielded isolation dry type. The primary winding shall be isolated and insulated from the secondary winding using copper electrostatic shield.

The transformers shall be provided with an electrostatic shield, primary surge suppression and secondary filters to attenuate transverse surges (across-the-line) and transients.

The 112.5 kVA transformer shall be three phase for connection to 480 volt ac primary and 208/120 volt secondary. The 45 kVA transformer shall be three phase for connection to 208 volt ac primary and 208/120 volt secondary.

2.2 FACTORY FINISH

Transformers shall be provided with the paint finish as specified in Section 16003, "General Electrical Provisions".

PART 3 EXECUTION

3.1 INSTALLATION

Dry type transformers shall be installed on resilient vibration-isolating mountings and connected with flexible metallic conduit to prevent transmission and amplification of sound.

Pad-mounted distribution transformers shall be installed on existing concrete pads and shall be grounded to a ground grid.

3.2 FIELD TESTING

3.2.1 Insulation-Resistance Tests

Transformer windings shall be given an insulation-resistance test using the following test set versus voltage level criteria:

Dry type 480- to 600-volt transformers - 1,000-volt test set

Dry type 240-volt and below transformers - 500-volt test set

Tests shall be applied for not less than 5 minutes and until three equal consecutive readings, 1 minute apart, are obtained. Readings shall be recorded every 30 seconds during the first 2 minutes and every minute thereafter. Minimum acceptable resistance shall be 100 megohms for pad transformers only.

3.2.2 Acceptance

Final acceptance shall depend upon the successful performance of the equipment under test. Transformers shall not be energized until recorded test data have been approved by the Contracting Officer.

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SECTION 16286

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2.3 CIRCUIT BREAKERS
2.3.1 Molded-Case Circuit Breakers
2.4 FUSES
2.5 CONTROL DEVICES
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PART 3 EXECUTION

3.1 INSTALLATION
3.2 FIELD TESTING

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SECTION 16286

OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.23	(1989) Electric Lamps - Incandescent Lamps-Miscellaneous Types

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

JOINT INDUSTRIAL COUNCIL (JIC)

JIC-01	(1967) Electrical Standards for Mass Production Equipment

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electric Equipment (1000 Volts Maximum)
NEMA AB 1	(1994) Molded Case Circuit Breakers and Molded Case Switches
NEMA AB 3	(1993) Molded Case Circuit Breakers and Their Application
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) General Standards for Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control Devices and Assemblies
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	(1991; 8th Ed; May 1, 1992; Bulletin Feb 11, 1992; Bulletin Mar 16, 1992) UL Standard for Safety Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 50	(1995; 11th Ed) UL Standard for Safety - Enclosures for Electrical Equipment
UL 508	(1993; 16th Ed) UL Standard for Safety Industrial Control Equipment

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Equipment and Performance Data shall be submitted for the following items including use life, system functional flows, safety features, and mechanical automated details.

Motor Controls
Circuit Breakers
Fuses
Control Devices
Indicating Lights

Manufacturer's Catalog Data shall be submitted for the following items:

Motor Controls
Enclosures
Circuit Breakers
Fuses
Control Devices
Indicating Lights

SD-04 Drawings

Connection Diagrams shall be submitted showing the relations and connections of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Control Devices

SD-09 Reports

Test Reports shall be submitted for the following tests on control and protective devices in accordance with the paragraph entitled, "Field Testing, of this section.

Operation Tests

Dielectric Tests

SD-13 Certificates

Certificates of Compliance shall be submitted for Circuit Tests on similar motor-control or motor-circuit protector (MCP) units under actual conditions may be submitted in lieu of factory tests on the actual units provided.

1.3 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

PART 2 PRODUCTS

2.1 MOTOR CONTROL

Motor controllers shall conform to NEMA ICS 1, NEMA ICS 2, and UL 508. Controllers shall have thermal overload protection in each phase.

2.1.1 Magnetic Motor Controllers

2.1.1.1 Full-Voltage Controllers

Magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors shall be full-voltage, full magnetic devices in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508.

Operating coil assembly shall operate satisfactorily between 85 and 110 percent of rated coil voltage. Motor control circuits shall be 120 volts, 60 hertz.

Controller shall be provided with two normally open and two normally closed auxiliary contacts rated per NEMA ICS 1 and NEMA ICS 2 in addition to the sealing-in contact for control circuits.

Solderless pressure wire terminal connectors shall be provided for line-and load-connections to controllers.

Overcurrent protection shall include three manual reset thermal overload devices, one in each pole of the controller. Thermal overload relays shall be bimetallic nonadjustable type with continuous current ratings and service-limit current ratings and shall have a plus or minus 15 percent adjustment to compensate for ambient operating conditions.

An externally operable manual-reset button shall be provided to re-establish control power to the holding coil of the electromagnet. After the controller has tripped from overload, resetting the motor-overload device shall not restart the motor.

Enclosure shall be in accordance with NEMA 250, Type 1.

2.1.2 Combination Motor Controllers

2.1.2.1 Reversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

Reversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors shall include two interlocked magnetic controllers with molded-case circuit breaker or MCP, with selector switch or forward/reverse/stop pushbutton and two indicating lights in the cover of the enclosure. Indicating lights shall indicate the forward and reverse running connection of the motor controller.

Rating of three-phase single-speed full-voltage magnetic controllers for plug-stop, plug-reverse, or jogging duty shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

Wiring and connections for full-voltage single-speed magnetic controllers shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2 ENCLOSURES

2.2.1 Equipment Enclosures

Enclosures for equipment shall be in accordance with NEMA 250.

Equipment installed in wet locations shall be contained in NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosures, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

Equipment installed in dry industrial locations shall be contained in NEMA Type 12 industrial use, sheet-steel enclosures constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Sheet-steel enclosures shall be fabricated from uncoated carbon-steel sheets of commercial quality, with box dimensions and thickness of sheet steel in accordance with UL 50.

Steel enclosures shall be fabricated from corrosion-resistant, chromium-nickel steel sheet conforming to ASTM A 167 Type 300 series with ASM No. 4 general-purpose polished finish. Box dimensions and thickness of sheet steel shall be in accordance with UL 50.

Ferrous-metal surfaces of electrical enclosures shall be cleaned, phosphatized, and painted with the manufacturer's standard finish.

2.3 CIRCUIT BREAKERS

Circuit breakers shall conform to UL 489, NEMA AB 1, and NEMA AB 3.

2.3.1 Molded-Case Circuit Breakers

Circuit breakers shall be molded case, manually operated, trip-free, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Circuit breakers shall be completely enclosed in a molded case, with the calibrated sensing element

factory-sealed to prevent tampering.

Thermal-magnetic tripping elements shall be located in each pole of the circuit breaker and shall provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Instantaneous magnetic tripping element shall be adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Breaker size shall be as required for the continuous current rating of the circuit. Breaker class shall be as required.

Interrupting capacity of the panel and lighting branch circuit breakers shall be sufficient to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Circuit breaker interrupting capacities shall be a minimum of 22,000 amperes and shall conform to NEMA AB 3.

Multipole circuit breakers shall be of the common-trip type having a single operating handle and shall a have two-position on/off indication. Circuit breakers shall have temperature compensation for operation in an ambient temperature of 104 degrees F. Circuit breakers shall have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Breaker body shall be of phenolic composition. Breakers shall be capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Circuit breakers used for motor-circuit disconnects shall meet the applicable requirements of NFPA 70 and shall be of the motor-circuit protector type.

Circuit breakers used for service disconnection shall be the enclosed circuit-breaker type with external handle for manual operation. Enclosures shall be sheet metal with a hinged cover suitable for surface mounting.

2.4 FUSES

A complete set of fuses for all switches and switchgear shall be provided. Fuses shall have a voltage rating not less than the circuit voltage.

Fuses rated 30 amperes, 125 volts or less shall be the nonrenewable cartridge type. Fuses rated above 30 amperes 600 volts or less shall be the renewable cartridge type with time-delay dual elements, except where otherwise indicated. Fuses shall conform to NEMA FU 1.

Fuses shall be labeled showing UL class, interrupting rating, and time-delay characteristics, when applicable.

Fuse holders field-mounted in a cabinet or box shall be porcelain. Field installation of fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber shall not be used.

2.5 CONTROL DEVICES

2.5.1 Control-Circuit Transformers

Control-circuit transformers shall be provided within the enclosure of

magnetic contactors and motor controllers when the line voltage is in excess of 120 volts. Transformer shall be encapsulated dry type, single-phase, 60-hertz, with a 120-volt isolated secondary winding.

Rated primary voltage of the transformer shall be not less than the rated voltage of the controller. Rated secondary current of the transformer shall be not less than continuous-duty current of the control circuit.

Voltage regulation of the transformer shall be such that, with rated primary voltage and frequency, the secondary voltage shall not be less than 95 percent nor more than 105 percent of rated secondary voltage.

Source of supply for control-circuit transformers shall be the load side of the main disconnecting device. Secondary winding of the transformer and control-circuit wiring shall be protected against overloads and short circuits with fuses selected in accordance with JIC-01. Secondary winding of the control-circuit transformer shall be grounded in accordance with JIC-01.

2.5.2 Pushbuttons and Switches

2.5.2.1 Pushbuttons

Pushbuttons for low-voltage ac full-voltage magnetic controllers shall be heavy-duty oiltight NEMA 250, Type 12, momentary-contact devices rated 600 volts, with pilot light, and with the number of buttons and the marking of identification plates as shown. Color code for pushbuttons shall be in accordance with JIC-01.

Pushbuttons shall be designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts. Pushbutton-contact ratings shall be in accordance with NEMA ICS 1 and NEMA ICS 2 with contact designation A600.

Pushbuttons in remote control stations shall be identified with identification plates affixed to front cover in a prominent location. Identification plate shall carry the identification of the system being controlled.

2.5.2.2 Selector Switches

Selector switches for low-voltage control circuits shall be heavy-duty oiltight maintained-contact devices with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.

Selector switches in remote control stations shall be identified with engraved identification plates affixed to front cover in a prominent location. Identification plate shall carry the identification of the system being controlled.

2.6 FACTORY TESTING

Factory tests on control and protective devices shall be performed in accordance with the manufacturer's recommendations.

Short-circuit tests shall be in accordance with Section 2 of NEMA ICS 1.

2.7 INDICATING LIGHTS

2.7.1 General-Purpose Type

Indicating lights shall be oiltight instrument devices with threaded base and collar for flush-mounting, translucent convex lens, candelabra screw-base lampholder, and 120-volt, 6-watt, Type S-6 incandescent lamp in accordance with ANSI C78.23. Color code for indicating lights shall be in accordance with JIC-01.

Indicating lights shall be provided in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

PART 3 EXECUTION

3.1 INSTALLATION

Control and protective devices not factory installed in equipment shall be installed in accordance with the manufacturer's recommendations and shall be field adjusted and tested for operation. Installations shall conform to NFPA 70, NEMA ICS 1, NEMA ICS 2, and NEMA ICS 3 requirements for installation of control and protective devices.

3.2 FIELD TESTING

Control and protective devices not factory installed in equipment shall be demonstrated to operate as indicated.

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SECTION 16446

PANELBOARDS

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SECTION 16446

PANELBOARDS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electric Equipment (1000 Volts Maximum)
NEMA AB 1	(1994) Molded Case Circuit Breakers and Molded Case Switches
NEMA PB 1	(1990) Panelboards

UNDERWRITERS LABORATORIES (UL)

UL 67	(1993; 11th Ed) Panelboards

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Panelboards
Directory Card and Holder
Filtered Panelboard

SD-09 Reports

Test Reports shall be submitted for the following tests in accordance with the paragraph entitled, "Field Testing," of this section. Panelboards shall not be energized until the recorded test data have been submitted to and approved by the Contracting

Officer.

Continuity Tests
Insulation Tests

SD-13 Certificates

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

SD-14 Samples

Panelboard keys shall then be properly tagged and delivered to the Contracting Officer.

PART 2 PRODUCTS

2.1 PANELBOARDS

Power-distribution panelboards shall be totally enclosed in a steel cabinet, dead-front circuit breaker type with copper buses, surface-mounted as indicated. Panelboards shall conform to NEMA PB 1 and NEMA AB 1. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.

Door-in-door construction shall be provided for all panels. An outer door or cover, hinged on one side, shall be provided on panelboards to provide gutter space access. A second center door, hinged on one side, shall be provided for circuit breaker/switch access only.

Voltage and current rating, number of phases, and number of wires shall be as indicated. Four-wire distribution panelboards shall be provided with an isolated full-capacity neutral bus. Panelboards shall be rated for 120/208-volt, three-phase and 277/480-volt, three-phase, 60-hertz current.

Three-phase, 4-wire distribution and branch circuit panelboards shall be provided with an isolated full-capacity copper bus providing spaces for single-pole circuit breakers/switches and spaces indicated as spare.

Panelboards shall be provided with a separate copper grounding bus bonded to the enclosure. Grounding bus shall be a solid copper bus bar of rectangular cross section equipped with binding screws for the connection of equipment grounding conductors.

Each panelboard, as a complete unit, shall have a short-circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or as indicated.

Panelboards and main breaker shall have current ratings as shown on the panelboard schedule.

Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard busing shall be such that when any two adjacent single-pole breakers are connected to opposite phases, two-pole breakers can be installed in any location. Three-phase, four-wire busing shall be such

that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two- or three-pole breakers can be installed at any location. Current-carrying parts of the bus assembly shall be plated. Mains ratings shall be as shown.

Mechanical lugs furnished with panelboards shall be cast copper or copper alloys of sizes suitable for the conductors indicated to be connected thereto.

Panelboard box shall be galvanized, rust-resistant code-gage sheet steel without knockouts. Entire panelboard front shall be hinged on one side with a piano hinge for the full height and shall also have captive screws opposite the hinged side. Where panelboards are installed flush with the walls, the installation details shall be such that the hinged front can be opened without damage to the adjacent wall surfaces. Color of the finished coat of trim and front shall match the adjacent walls except that when the box is installed in electrical closets or equipment rooms, the gray finish as specified will be acceptable.

Panelboard enclosures shall be NEMA 250, Type 1. Enclosures shall be provided with hinged fronts and corrosion-resistant steel pin-tumbler cylinder locks. Locks shall be keyed alike, and two keys shall be provided for each enclosure.

Panelboards shall be finished with baked enamel. Finish color shall be No. 61 gray conforming to FED-STD 595.

2.2 CIRCUIT BREAKERS

Circuit breakers shall be the molded-case type as specified in Section 16286, "Overcurrent Protective Devices." Frame and trip ratings shall be as indicated.

2.3 DIRECTORY CARD AND HOLDER

A directory card shall be mounted on the inside of hinged fronts and doors 0.030-inch thick minimum plastic in a metal frame, with spaces for circuit numbers, outlets controlled, and room numbers. Where hinged fronts or doors are not required, the directory card shall be provided under glass 0.030-inch thick minimum plastic in a metal frame mounted on the left-hand side of the front trim. Directory card shall identify each branch circuit with its respective and numbered circuit breaker.

2.4 FACTORY TESTING

Complete panelboards shall be tested in accordance with UL 67.

2.5 PRECAUTIONARY LABEL

To ensure persons are aware of immediate or potential hazard in the application, installation, use, or maintenance of panelboards, each panelboard shall be conspicuously marked on the trim or dead front shield with the text (or equivalent) **DANGER** symbol. If the panel is supplied with a door, the label shall be visible when the door is in the open position.

PART 3 EXECUTION

3.1 INSTALLATION

Panelboards shall be installed as indicated and in accordance with the manufacturer's instructions. Panels shall be fully aligned and mounted so that the height of the top operating handle will not exceed 72-inches above the finished floor.

Directory-card information shall be typewritten in capital letters to indicate outlets controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.

3.2 FIELD TESTING

Each panelboard enclosure key shall be shown to operate the enclosure locks in the presence of the Contracting Officer.

Panelboards shall be given continuity and insulation tests after the installation has been completed and before the panelboard is energized.

Test equipment, labor, and personnel shall be provided by the Contractor as required to perform the tests as specified. Continuity tests shall be conducted using a dc device with bell or buzzer.

Insulation tests on 480-volt panelboards shall be conducted using a 1,000-volt insulation-resistance test set. Readings shall be recorded every minute until three equal and consecutive readings have been obtained. Resistance between phase conductors and between phase conductors and ground shall be not less than 50 megohms.

Insulation tests on panelboards rated 300 volts or less shall be conducted using a 500-volt minimum insulation-resistance test set. Readings shall be recorded after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Test data shall be recorded and shall include the location and identification of panelboards and megohm readings versus time.

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SECTION 16511

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SECTION 16511

FLUORESCENT LUMINAIRES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1	(1991) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
ANSI C78.3	(1991) Dimensional and Electrical Characteristics of Fluorescent Lamps - Instant-Start and Cold-Cathode Types
ANSI C82.1	(1997) Ballasts for Fluorescent Lamps
ANSI C82.2	(1984; Rev 1995) Fluorescent Lamp Ballasts - Methods of Measurement

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 270	(1988) Procedure for Fluorescent Lamp/Ballast/Fixture Performance Comparison

UNDERWRITERS LABORATORIES (UL)

UL 1570	(1995) UL Standard for Fluorescent Lighting Fixtures
UL 935	(2001) Fluorescent-Lamp Ballasts

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

Fluorescent fixture performance requirements shall be rated in accordance with NEMA 270.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Fluorescent Lighting Fixtures
Fluorescent Lamp Ballast
Fluorescent Lamps
Accessories

SD-13 Certificates

Certificates of Compliance shall be submitted for the following showing conformance with the referenced standards contained in this section.

Fluorescent Lighting Fixtures
Fluorescent Lamp Ballast
Fluorescent Lamps
Accessories

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Fluorescent lighting fixtures shall conform to UL 1570 and as specified.

Lighting fixtures shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations indicated. Recessed fixtures in suspended ceilings shall be designed and equipped for installation in the type of ceiling in which the fixture is to be installed. Fixtures shall be designed to be supported independent of the ceiling and shall be equipped with the lamps indicated.

2.2 COMMERCIAL FIXTURES

Commercial fluorescent lighting fixtures shall conform to UL 1570 and include recessed, surface-mounted, and pendant-mounted luminaires as indicated and herein specified.

Lighting fixtures shall include wiring channel, end plates, end caps, side panels, top reflectors, bottom closures, lampholders, lamps, ballasts, suspension stems, wiring, and other necessary materials and devices.

Ballasts and wiring shall be completely enclosed in the wiring channel and shall be easily accessible. Ballast shall be replaceable without removing the fixture from its mounting. Lamps shall be replaceable without the use of tools and without removal of other lamps and equipment.

Wiring channel, end plates, and other sheet steel enclosure components shall be cold-rolled carbon-steel sheet, of commercial quality, not less than20 gage.

2.2.1 Recessed Fixtures

Recessed fixtures in suspended ceilings shall be equipped with frames, yokes, and adjustable mounting brackets designed for the type of ceiling construction in which the fixture is to be installed. Bottom closure shall be hinge framed with chromium or nickel-plated latching devices.

2.2.2 Pendant-Mounted Fixtures

Pendant-mounted fixtures shall be equipped with stems, swivel,

ball-and-socket self-aligning hangers, ceiling canopies, and fixture-leveling devices. Stems shall be not less than 1/2 inch in diameter, made from seamless aluminum or corrosion-resistant steel tubing. Stem length, material, and finish shall be as indicated.

2.3 INDUSTRIAL FIXTURES

Industrial fluorescent lighting fixtures shall conform to UL 1570 and shall be as indicated.

Lower edge of the reflector shall be formed into a flange or bead to provide stiffness and shall be completely covered by the finish. Each reflector shall be removable and securely maintained in position with latch fastening devices. Reflector shall form the bottom of the wiring-channel enclosure.

Direct-lighting fixture reflectors shall be so shaped that the ratio of the candlepower at 55 degrees nadir to the candlepower at nadir shall be not less than 55 percent. Upward component of light shall be a minimum of 8 percent and a maximum of 20 percent of the total light output.

Lighting-fixture unit, when viewed at any angle from the minimum shielding angle to the horizontal plane, shall have a brightness no greater than 40 percent of the brightness of the bare lamp.

Pendant-mounted fixtures shall be equipped with straps, brackets, conduit stems, ball-and-socket self-aligning hangers, ceiling canopies, slide-clamp fixture hangers, and leveling devices. Stems shall be not less than 1/2 inch in diameter, seamless brass, steel, or aluminum tubing. Stem length and finish shall be as indicated. When two or more fixtures are joined together, the wiring channel shall form an open and continuous wireway.

Chain-supported fixtures shall be equipped with straps, brackets, ceiling-mounted chain hangers, chain, hooks, and slide-clamp fixture hangers.

2.4 FLUORESCENT LAMP BALLAST

Fluorescent lamp ballasts shall be Class P in accordance with ANSI C82.1, ANSI C82.2, and UL 935.

Ballasts shall be designed for single- or two-lamp operation with line power factor not less than 90 percent. Two-lamp ballasts shall operate the two lamps out of phase with each other. Lamp cathodes shall be continuously heated during lamp operation.

Fluorescent lighting fixtures with lamps 30 watts or more shall be equipped with rapid-start ballasts.

Ballasts shall be voltage rated for operation on 120-volt, single-phase, 60-hertz lighting distribution systems as indicated.

Ballasts shall be designed for a maximum ambient temperature of 105 degrees F.

Ballasts for indoor lamps shall be in accordance with UL 935 and shall be of the energy-efficient solid-state type. Energy-efficient ballasts shall be physically interchangeable with standard ballasts and have lower operating temperature than standard ballasts.

Energy-efficient solid-state ballasts shall have at least 45 percent less power losses than standard ballasts or maximum allowable power loss of 10 watts, an extended life of at least twice that of standard ballasts.

Solid-state ballasts shall not contain polychlorinated biphenyls (PCBs).

Solid-state ballasts shall operate with a 90 to 110 percent input voltage variation at an input frequency of 60 Hz. Light output shall remain constant for line voltage fluctuations of plus or minus 3 percent. Ballasts shall be rapid start type.

Ballasts shall have a minimum power factor of 0.95.

Ballasts shall comply with Class A sound rating.

Ballasts shall comply with Electromagnetic Interference (EMI) and Radio Interference (RFI) limits set by the FCC Part 18, CFR, Chapter 18.

Ballasts shall have less than 10 percent Total Harmonic Distortion.

Ballasts for rapid start lamps T-8 shall be capable of operating remaining lamps if one or more companion lamps fail or are removed.

2.5 FLUORESCENT LAMPS

Lamps shall conform to ANSI C78.1 or ANSI C78.3 and shall be the energy-efficient low mercury content type with a minimum starting temperature of 60 degrees F.

2.5.1 Rapid Start Lamp

The 32-watt, extra-high efficiency fluorescent lamp shall have a minimum efficiency of 91 lumens per watt and shall be designed to operate on an energy efficient solid-state electronic ballast.

Rapid start lamps shall have bulb designation T-8 with a nominal length of 48 inches, a base configuration of medium bipin contact.

Lamps shall have an average rated life at 3 hours per start of 20,000 hours. Initial lumens after 100 hours burning shall be 2,925 or 2,850 with 2,570 or 2,500 lumens at 40 percent of lamp life.

Bulb color shall be Cool White. Lamp dimensions shall be in accordance with ANSI C78.1.

Lamps shall have low mercury content type specified on contract drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Fluorescent fixtures shall be installed in accordance with UL 1570.

A fixture shall be installed at each outlet indicated, and lamps of the proper type and wattage shall be installed in each fixture.

New lamps shall be installed immediately prior to completion of the project.

Fixtures shall be installed parallel and perpendicular to major axes of structures and shall be plumb and aligned to a tolerance of 1/2 inch in 10 feet.

Supports for recessed fixtures shall have a minimum capacity of 150 pounds, and all parts of the support shall be arranged to prevent them from vibrating free.

Supports for recessed fixtures in suspended ceilings shall be so arranged that each corner of each fixture is supported by a hanger wire anchored to a structural member or to the structure. Fixture shall not be supported by the suspended ceiling structure.

Surface-mounted fixtures shall be attached securely to structural members or to metal supports that span structural members. Fixtures shall be fastened near each end.

Fixtures located in equipment rooms shall be so installed that they clear all obstructions such as duct, piping, bracing, and supports.

3.2 FIELD TESTING

Fluorescent lighting fixtures shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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SECTION 16512

HIGH INTENSITY DISCHARGE (HID) LUMINAIRES

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SECTION 16512

HIGH INTENSITY DISCHARGE (HID) LUMINAIRES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1375	(1996) Metal-Halide 400-watt, M59 Single-Ended Lamps
ANSI C78.1376	(1996) Metal-Halide Lamp, 1000-watt, M47
ANSI C82.4	(1985; C82.4a-1988) Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple Supply Type)
ANSI C82.5	(1990) Reference Ballasts - High-Intensity-Discharge and Low Pressure Sodium Lamps
ANSI C82.9	(1988) High-Intensity-Discharge and Low-Pressure Sodium Lamps, Ballasts and Transformers - Definitions

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1572	(1995) UL Standard for High Intensity Discharge Lighting Fixtures

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Lighting Fixtures

Lamp Ballasts
Lamps
Lighting-Distribution Curves

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

High-intensity-discharge (HID) lighting fixtures shall conform to UL 1572 and as indicated.

Lighting fixtures shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations indicated. Fixtures shall be equipped with the lamps indicated.

2.2 COMMERCIAL FIXTURES

HID lighting fixtures shall be of the types and designs indicated, completely assembled, wired, and ready for connection to the building lighting-distribution system.

2.3 LAMP BALLASTS

2.3.1 Multiple-Circuit Ballasts

Multiple-circuit ballast shall include a two-winding core-and-coil assembly with a saturated-iron regulating element and capacitors impregnated with an insulating material in accordance with ANSI C82.4, ANSI C82.5, and ANSI C82.9.

Ballast shall maintain correct lamp operation over a voltage-input range of plus or minus 13 percent of rated voltage. Capacitors shall provide a power-factor lamp load not less than 95 percent.

Ballasts shall be voltage rated for operation on 120-volt, single-phase, 60-hertz lighting-distribution systems, as indicated.

Ballasts shall be designed for a minimum lamp starting temperature of minus 20 degrees F and a maximum ambient temperature of 105 degrees F.

2.4 LAMPS

HID lamps shall be metal halide conforming to ANSI C78.1375 and ANSI C78.1376.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be performed in accordance with NFPA 70.

HID fixtures shall be installed at each outlet indicated, and lamps of the proper type, voltage, and wattage shall be installed in each fixture.

New lamps shall be installed immediately prior to completion of the project. Lamps shall be installed with the light center at the focal point of the reflector and in the proper burning position.

3.2 FIELD TESTING

HID lighting fixtures and their accessories, including lowering devices, shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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SECTION 16513

INCANDESCENT LUMINAIRES

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PART 3 EXECUTION

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SECTION 16513

INCANDESCENT LUMINAIRES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1571	(1991; 3rd Ed) UL Standard for Safety Incandescent Lighting Fixtures

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Incandescent Lighting Fixtures

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Incandescent lighting fixtures shall conform to UL 1571.

Lighting fixtures shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations noted. Recessed fixtures in suspended ceilings shall be designed and equipped for installation in the type of ceiling in which the fixture is to be installed. Fixtures shall be designed to be supported independent of the ceiling. Fixtures shall be equipped with the lamps required.

2.2 COMMERCIAL FIXTURES

Commercial incandescent lighting fixtures include recessed, surface mounted, and pendant-mounted luminaires.

Metal parts of lighting fixtures shall be corrosion-resistant nonferrous metal or sheet steel with corrosion-resistant finish. Solder or self-threading sheet metal screws shall not be used in the construction of the fixture enclosure.

Fixtures rated up to and including 300 watts shall be equipped with medium screw-base lampholders. Screw shells of lampholders shall be electrically connected to the metal part of lighting fixtures or equipment grounding-circuit conductor.

2.2.1 Recessed Fixtures

Recessed fixtures in suspended ceilings shall be designed for the type of ceiling construction in which the fixture is to be installed. Combustible ceiling materials shall not be subject to temperatures in excess of 195 degrees F. Where recessed fixtures are supported on suspended ceilings, the ceiling shall have a minimum of four support rods per fixture with no support further than 6 inches from the edge of the fixture. Fixtures shall not be supported by acoustic panels.

2.3 INCANDESCENT LAMPS

General-purpose lamps shall be clear. Lamps with wattage ratings up to and including 300 watts shall have medium brass screw bases.

Special-purpose lamps include PAR lamps. PAR lamps shall have clear, molded, heat-resistant, hard-glass bulbs with parabolic, aluminized, inner-bulb wall reflector for spot- or flood-lighting applications.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be performed in accordance with NFPA 70 and in accordance with the manufacturer's installation instructions.

A fixture shall be installed at each outlet indicated, and lamps of the proper type, voltage, and wattage shall be installed in each fixture.

New lamps shall be installed immediately prior to completion of the project. Lamps shall be installed with the light center at the focal point of the reflector and in the proper burning position.

Fixtures located in equipment rooms shall be so installed that they clear all obstructions such as duct, piping, bracing, and supports.

3.2 FIELD TESTING

Incandescent lighting fixtures and their accessories, including lowering devices, shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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SECTION 16535

EMERGENCY LIGHTING

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1.3 SUBMITTALS

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS
2.2 EMERGENCY LIGHTING EGRESS UNITS

PART 3 EXECUTION

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3.2 FIELD TESTING

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SECTION 16535

EMERGENCY LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Code for Safety to Life from Fire in Buildings and Structures
NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 924	(1995; 8th Ed) UL Standard for Safety Emergency Lighting and Power Equipment

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Emergency Lighting Egress Units
Accessories

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Emergency lighting units shall conform to UL 924 and NFPA 101.

Emergency lighting units shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations indicated. Fixtures shall be equipped with lamps.

2.2 EMERGENCY LIGHTING EGRESS UNITS

Emergency lighting units shall be complete self-contained units with batteries, battery charger, one or more local or remote lamp heads with

lamps, under-voltage relay, indicator lights, on/off switch, and test switch, in accordance with UL 924 for Type I (emergency light set), Class I (rechargeable storage-battery-powered unit), Style D (nonrefillable nickel-cadmium battery), as indicated.

Batteries shall be rated not less than 12 volts.

Battery charger shall include a dry-type full-wave rectifier with two charging rates, one to automatically maintain the battery in a fully charged state under normal conditions and the other to automatically recharge the battery to a fully charged state within 12 hours after continuous discharge of 1-1/2 hours through the connected lampload.

Batteries shall have capacity and rating to supply the lamp load with maintained 87.5-percent power, minimum, for 1.5 hours. Batteries shall be maintenance-free nickel-cadmium type. Minimum normal life shall be 15 years.

Unit enclosure shall be fabricated from sheet steel not less than 18 gage. Cover shall provide access to the battery and battery-charger compartments and shall have a full-length piano hinge and a latching device. Component parts within the enclosure shall be protected from dust, moisture, and oxidizing fumes from the battery. Interior and exterior surfaces of enclosure shall be coated with a corrosion-resistant gray baked-enamel finish.

Lamps shall be the sealed-beam type halogen, rated not less than 9 watts at the specified dc voltage.

An amber "ready-for-use on alternating current" indicating light, a red "recharging on alternating current" indicating light, and a momentary-contact pushbutton test switch shall be mounted on the cover of the unit enclosure. The amber indicating light shall indicate, when illuminated, that the unit is electrically connected to the normal ac supply source and that the battery is fully charged. The red indicating light shall indicate, when illuminated, that the battery is being recharged. The momentary-contact pushbutton test switch shall transfer unit from normal supply to battery supply and shall test operation of equipment under simulated ac source power failure.

The under-voltage relay shall be the self-clearing type and shall automatically connect the lampload to the battery supply upon failure of the alternating current supply. An on-off toggle switch shall be mounted inside the unit enclosure to disconnect the battery from the lampload when the unit is taken out of service for maintenance purposes. The relay shall energize when the ac supply falls to 70 percent of normal voltage.

Emergency lighting units shall be provided with mounting brackets designed by the equipment manufacturer for this purpose. The mounting brackets shall be coated with a corrosion-resistant finish in accordance with manufacturer's standard practice.

Emergency lighting units shall be suitable for operation on the ac supply circuit to which they are to be electrically connected.

PART 3 EXECUTION

3.1 INSTALLATION

Emergency lighting unit shall be permanently fixed in place and shall have wiring to each unit installed in accordance with NFPA 70. The branch circuit feeding the unit equipment shall be the same panel bus or branch circuit as that serving the normal lighting in the area and shall be connected ahead of area switches. Emergency lighting fixtures that are remotely connected to the emergency lighting unit shall have circuit wiring kept independent of all other wiring and equipment and shall not enter the same conduit, cable, box, or cabinet with other wiring unless the fixture is supplied from two sources.

Mounting heights of emergency lighting units and remote lamps shall be a minimum of 7-feet above the finished floor.

3.2 FIELD TESTING

Emergency lighting units shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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SECTION 16536

EXIT LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Code for Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES (UL)

UL 924	(1995; 8th Ed) UL Standard for Safety Emergency Lighting and Power Equipment

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Exit Lighting Units
Accessories

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Emergency exit lighting fixtures shall conform to UL 924, NFPA 101, and as specified.

Exit lighting fixtures shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations indicated. Ceiling-mounted fixtures shall be designed to be supported independent of the ceiling. Fixtures shall be equipped with lamps.

2.2 LIGHT EMITTING DIODES (LEDs) EXIT LIGHTING FIXTURES

Exit lighting fixtures shall include sheetmetal enclosures with frames, battery charger, batteries, green light emitting diodes (LEDs) and mounting

brackets. Fixtures shall be single or double faced as required by contract drawings. Mounting plates shall be suitable for securing the fixture to a 4-inch outlet box. Fixture features shall include continuous charging, automatic switching to standby batteries upon loss of power, overload protection, short circuit protection, test switch, low voltage disconnect, switch controlled left and right LED directional arrows, and shall be field connectable to operate from 120 volts. Minimum operating time of the battery system shall be three (3) hours for double faced fixtures and seven (7) hours for single faced fixtures. Brightness shall not be less than ten (10)candlepower. All components shall have a five year warranty.

PART 3 EXECUTION

3.1 INSTALLATION

Fixtures shall be connected to the main panel bus through overcurrent protection. Emergency lighting panel shall be used where available.

3.2 FIELD TESTING

Exit lighting shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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SECTION 16760

PAGING SYSTEM SPEAKERS

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.2 (ASA 85)	1989 Measuring the Intelligibility of Speech Over Communication Systems

FEDERAL SPECIFICATIONS (FS)

FS J-C-30	(Rev. B) (Am. 1) Cable and Wire, Electrical (Power, Fixed Installation)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES INC.(UL)

UL 6	(2000) UL Standard for Safety - Rigid Metal Conduit
UL 50	(1995; 11th Ed) UL Standard for Safety - Enclosures for Electrical Equipment
UL 797	(2000) UL Standard for Safety - Electrical Metallic Tubing

1.3 RELATED REQUIREMENTS

Section 16003, "General Electrical Provisions" applies to this section, with the additions and modifications specified herein.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittals."

SD-01 Data

Manufacturer's Catalog Data for:

Paging System Equipment
Cables and Raceways

PART 2 PRODUCTS

2.1 EQUIPMENT AND COMPONENTS

Equipment and components shall conform to applicable requirements of NFPA 70. Units of the same type of the equipment shall be product of single manufacturer.

2.1.1 Paging System

Provide paging system including speakers and interconnecting cables. All speakers shall operate from a 70 volt distribution system of existing amplifier.

2.1.1.1 Cone Speaker

Provide ceiling-mounted cone type speakers. Include rust-proof back boxes of acoustically damped construction, minimum 20 gage steel or aluminum; provide for relief of back pressure. Include suitable recessed mounted speaker grille, made of 20 gage minimum steel or aluminum. Speaker assembly shall as a minimum conform to the following specifications:

a.	Sensitivity (Sound Pressure Level)	Minimum of 92 dB, measured at 1 watt input, 4 feet on axis
b.	Frequency Response Ratio	Plus or minus 3 dB from 80 Hz to 12,000 Hz
c.	Dispersion Angle	90 degrees
d.	Transformer with 4 Level Taps	1/2, 1, 2, 5 watts
e.	Voice Coils	1 inch

2.2 CABLES AND RACEWAYS

Cable and raceways shall conform to FS J-C-30, UL 6, and UL 797. Cabinets and boxes shall conform to UL 50.

2.2.1 Speaker Cable

Basic cables shall be single twisted pair shielded cables, 18 gage, stranded tinned copper with vinyl insulation aluminum polyester shield, stranded tinned copper wire with overall vinyl jacket.

2.3 TERMINALS

Terminals shall be solderless, tool-crimped pressure type.

2.4 SPEAKER ENCLOSURES

Speaker enclosures shall be compatible with the speakers specified and shall comply with UL 50.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Install all system components and appurtenances in accordance with the manufacturer's instructions and as specified herein.

3.1.2 Wiring

Wiring shall be installed in rigid metal conduit or electric metallic tubing as specified in Section 16145.

3.2 FIELD QUALITY CONTROL

3.2.1 Acceptance Tests

After installation has been completed, Contractor shall conduct an acceptance test in the presence of the Contracting Officer or its representative, to demonstrate that the equipment operates in accordance with specification requirements. Contractor shall notify the Contracting Officer 2 weeks prior to performance of tests. The acceptance tests shall include originating and accepting messages at specified stations, at proper volume levels, without cross-talk or noise from other links or non-designated units. Test shall utilize the phonetically balanced monosyllabic work intelligibility test in accordance with ANSI S3.2 (ASA 85). In order to be acceptable a score of at least 75 percent must be obtained for each system test.

3.2.2 Retesting

Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense.

3.3 INSPECTION

Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals identified.

-- End of Section --