AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		4

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0003	27 JUN 2000		

6. ISSUED BY CODE

US ARMY ENGINEER DISTRICT, FORT WORTH
ATTN: CESWF-CT (RM 2A19)
PO BOX 17300
FORT WORTH, TX 76102-0300

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE FACILITY CODE

(X)

☒ 9A. AMENDMENT OF SOLICIATION NO. DACA63-00-B-0021

9B. DATED *(SEE ITEM 11)* 15 MAY 2000

☐ 10A. MODIFICATION OF CONTRACT/ORDER NO.

10B. DATED *(SEE ITEM 11)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a)By completing items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

The Solicitation for SOLDIER SERVICE CENTER, FORT HOOD, TEXAS, is amended as follows:

See continuation Sheets:

NOTE: The bid opening time and date remains "2 pm local time, 11 July 2000" as previously announced.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

Item 14. Continued.

CHANGES TO BIDDING SCHEDULE

1. Write-in Change.- Add the following note to the Bidding Schedule:

"9. Apparent Low Bidder if he is Large Business shall submit SubContracting Plan within 2 calendar days following Bid Opening."

CHANGES TO THE SPECIFICATIONS

2. New Sections - Add the following accompanying new sections, each bearing the notation "ACCOMPANYING AMENDMENT NO. 0003 TO SOLICITATION NO. DACA63-00-B-0021:"

SECTION 08330 OVERHEAD ROLLING DOORS
SECTION 09840 ACOUSTICAL WALL TREATMENT
SECTION 13121 METAL BUILDING SYSTEMS (MINOR REQUIREMENTS)

3. Replacement Sections - Replace the following sections with the accompanying new sections of the same number and title, bearing the notation "ACCOMPANYING AMENDMENT NO. 0003 TO SOLICITATION NO. DACA63-00-B-0021:"

SECTION 01000 CONSTRUCTION SCHEDULE
SECTION 01420 BASIC STORMWATER POLLUTION PREVENTION PLAN
SECTION 04200 MASONRY
SECTION 06100 ROUGH CARPENTRY
SECTION 07510 BUILT-UP ROOFING
SECTION 07600 SHEET METALWORK, GENERAL
SECTION 08353 OPERABLE PARTITIONS
SECTION 08700 BUILDERS' HARDWARE
SECTION 09250 GYPSUM WALLBOARD
SECTION 09310 CERAMIC TILE
SECTION 09915 COLOR SCHEDULE
SECTION 13930 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION
SECTION 15400 PLUMBING, GENERAL PURPOSE
SECTION 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM
SECTION 16415 ELECTRICAL WORK, INTERIOR
SECTION 16770 RADIO AND PUBLIC ADDRESS SYSTEMS

CHANGES TO THE DRAWINGS

4. Replacement Drawings.- Replace the drawings listed below with the attached new drawings(s) of the same number, bearing the notation "AM #0003":

c16_3.cal Seq 16 C-16 GRADING PLAN 1 - BASE BID
c18_3.cal Seq 18 C-18 GRADING PLAN 3 - BASE BID + BID OPTIONS 2, 3, & 4
h01_3.cal Seq 35 H1 REGULATED MATERIAL SURVEY LOCATIONS AND QUANTITIES BUILDING NO. 107
h06_3.cal Seq 40 H6 EROSION AND SEDIMENT CONTROL PLAN 3

a01_3.cal	Seq 42	A1	Overall First Floor Plan
a02_3.cal	Seq 43	A2	Overall Second Floor Plan
a03_3.cal	Seq 44	A3	Overall Third Floor Plan
a04_3.cal	Seq 45	A4	First Floor Plan - Area A
a05_3.cal	Seq 46	A5	First Floor Reflected Ceiling Plan Area A
a06_3.cal	Seq 47	A6	First Floor Plan - Area B
a07_3.cal	Seq 48	A7	First Floor Reflected Ceiling Plan Area B
a08_3.cal	Seq 49	A8	Second Floor Plan - Area A
a09_3.cal	Seq 50	A9	Second Floor Reflected Ceiling Plan Area A
a10_3.cal	Seq 51	A10	Second Floor Plan - Area B
a11_3.cal	Seq 52	A11	Second Floor Reflected Ceiling Plan Area B
a12_3.cal	Seq 53	A12	Third Floor Plan - Area A
a13_3.cal	Seq 54	A13	Third Floor Reflected Ceiling Plan Area A
a14_3.cal	Seq 55	A14	Third Floor Plan - Area B
a15_3.cal	Seq 56	A15	Third Floor Reflected Ceiling Plan Area B
a16_3.cal	Seq 57	A16	Roof Plan
a17_3.cal	Seq 58	A17	Overall Building Elevations
a18_3.cal	Seq 59	A18	Building Elevations
a20_3.cal	Seq 61	A20	Building Section
a21_3.cal	Seq 62	A21	Wall Types
a22_3.cal	Seq 63	A22	Enlarged Floor Plans - Elevators / Stair B
a23_3.cal	Seq 64	A23	Enlarged Toilet Plans
a24_3.cal	Seq 65	A24	Enlarged Toilet / Locker Rooms
a25_3.cal	Seq 66	A25	Interior Elevations
a26_3.cal	Seq 67	A26	Stair Plans - Stairs A and C
a27_3.cal	Seq 68	A27	Stair Sections - Stair A and C
a28_3.cal	Seq 69	A28	Stair Section - Stair B
a29_3.cal	Seq 70	A29	!st Floor Room Finish Schedule
a30_3.cal	Seq 71	A30	2nd Floor Room Finish Schedule
a31_3.cal	Seq 72	A31	3rd Floor Room Finish Schedule
a32_3.cal	Seq 73	A32	Door Schedule
a33_3.cal	Seq 74	A33	Door Details
a34_3.cal	Seq 75	A34	Door Details
a35_3.cal	Seq 76	A35	Roof Details
a37_3.cal	Seq 78	A37	Miscellaneous Details
a38_3.cal	Seq 79	A38	Miscellaneous Details
i06_3.cal	Seq 85	I06	First Floor Signage Plan
i07_3.cal	Seq 86	I07	Second Floor Signage Plan
s01_3.cal	Seq 88	S-1	STRUCTURAL NOTES & MISCELLANEOUS DETAILS
s02_3.cal	Seq 89	S-2	NOT USED
s03_3.cal	Seq 90	S-3	FOUNDATION PLAN - AREA A
s04_3.cal	Seq 91	S-4	FOUNDATION PLAN - AREA B
s05_3.cal	Seq 92	S-5	FOUNDATION SECTIONS I
s06_3.cal	Seq 93	S-6	FOUNDATION SECTIONS & DETAILS II
s07_3.cal	Seq 94	S-7	NOT USED
s08_3.cal	Seq 95	S-8	SECOND FLOOR FRAMING PLAN - AREA A
s09_3.cal	Seq 96	S-9	SECOND FLOOR FRAMING PLAN - AREA B
s10_3.cal	Seq 97	S-10	2ND FLOOR SECTIONS I
s11_3.cal	Seq 98	S-11	NOT USED
s12_3.cal	Seq 99	S-12	THIRD FLOOR FRAMING PLAN - AREA A
s13_3.cal	Seq 100	S-13	THIRD FLOOR FRAMING PLAN - AREA B

s14_3.cal Seq 101 S-14 NOT USED
s16_3.cal Seq 103 S-16 ROOF FRAMING PLAN - AREA A
s17_3.cal Seq 104 S-17 ROOF FRAMING PLAN - AREA B
s18_3.cal Seq 105 S-18 NOT USED
s20_3.cal Seq 107 S-20 NOT USED
m02_3.cal Seq 109 M2 MECHANICAL SCHEDULES
m04_3.cal Seq 111 M4 MECHANICAL SCHEDULES
m17_3.cal Seq 124 M17 MECHANICAL YARD & MECH. RM. HVAC PLAN
m18_3.cal Seq 125 M18 MECHANICAL RM. HVAC PLAN & SECTIONS
m22_3.cal Seq 129 M22 HVAC DETAILS
p01_3.cal Seq 135 P1 PLUMBING PLAN, 1ST FLOOR
p02_3.cal Seq 136 P2 PLUMBING PLAN, 2ND FLOOR
p03_3.cal Seq 137 P3 PLUMBING PLAN, 3RD FLOOR
p04_3.cal Seq 138 P4 PLUMBING RISERS, WASTE & VENT
p05_3.cal Seq 139 P5 PLUMBING RISERS, SUPPLY
p06_3.cal Seq 140 P6 PLUMBING DETAILS
e107_3.cal Seq 154 E107 1ST FLOOR POWER PLAN - WING A
e108_3.cal Seq 155 E108 1ST FLOOR POWER PLAN - WING B
e109_3.cal Seq 156 E109 2ND FLOOR POWER PLAN - WING A
e110_3.cal Seq 157 E110 2ND FLOOR POWER PLAN - WING B
e111_3.cal Seq 158 E111 3RD FLOOR POWER PLAN - WING A
e112_3.cal Seq 159 E112 3RD FLOOR POWER PLAN - WING B
e402_3.cal Seq 167 E402 ENLARGED MECHANICAL ROOMS
e506_3.cal Seq 172 E506 POWER & COMMUNICATION DISTRIBUTION BOX DETAILS
e603_3.cal Seq 176 E603 PANEL SCHEDULES - 1ST FLOOR
e605_3.cal Seq 178 E605 PANEL SCHEDULES - 2ND FLOOR
e702_3.cal Seq 185 E702 EXTERIOR DEMOLITION PLAN
e703_3.cal Seq 186 E703 NEW EXTERIOR PLAN

END OF AMENDMENT

SECTION 01000

CONSTRUCTION SCHEDULE
01/2000
AMENDMENT 0003

PART 1 GENERAL

1.1 SCHEDULE

Commence, prosecute, and complete the work under this contract in accordance with the following schedule and Section 00800 SPECIAL CONTRACT REQUIREMENT clauses COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK and LIQUIDATED DAMAGES:

Item of Work	Commencement of Work (calendar days)	Completion of Work (calendar days)	Liquidated Damages per calendar day[1]
(1) All Work unless otherwise stated	Within 10 days after receipt of Notice to Proceed	540	$ 1,630.00
(2) New 48th Street	330 days after Contract N.T.P.	45	$ 300.00
(3) Design and Submittal of Pedestrian Bridge (Bid Option #2) To Government for Review	within 10 days after N.T.P. of Option #2	60	$ 100.00
(4) Construction of Bridge (Bid Option #2)	After Gov't Approval of Contractor's Design	120	$ 300.00
(5) Bid Option #1 (Off-Site Building Demolition)			
(5a) Bldg. #107	60 days after Completion of Soldier Service Center	30	$ 200.00
(5b) Bldg. #108	After Completion of Item 5a	30	$ 200.00

(5c) Bldg. #134	After Completion of Item 5b	30	$ 200.00
(6) Bid Option #3 New Signal Light	400 days after Contract N.T.P.	60	$ 200.00
(7) Establishment of Turf	*	*	---
(8) Landscaping	**	**	---

[1]Liquidated damages are not accummulative.

NOTE: See Contract Drawings for additional phasing requirements.

*Establishment of Turf

Planting and maintenance for turfing shall be in accordance with Section 02932 ESTABLISHMENT OF TURF. No payment will be made for establishment of turf until all requirements of the section are adequately performed and accepted, as determined by the Contracting Officer.

**Landscaping

Planting and maintenance for landscaping shall be in accordance with Section 02930 EXTERIOR PLANTING and 02940 MULCHING FOR EROSION CONTROL. No payment will be made for landscaping until all requirements of the section are adequately performed and accepted, as determined by the Contracting Officer.

1.1.1 Testing of Heating and Air-Conditioning Systems

The times stated for completion of this project includes all required testing specified in appropriate specification sections of heating, air conditioning and ventilation systems including HVAC Commissioning. Exception: boiler combustion efficiency test, boiler full load tests, cooling tower performance tests, and refrigeration equipment full load tests, when specified in the applicable specifications, shall be preformed in the appropriate heating/cooling season as determined by the Contracting Officer.

1.2 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (OCT 1989) (ER 415-1-15)(52.0001-4038 1/96)

a. This provision specifies the procedure for determination of time extensions for unusually severe weather in accordance with the contract clause entitled "Default: (Fixed Price Construction)." In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

(1) The weather experienced at the project site during the contract period

must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

(2) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

b. The following schedule of monthly anticipated adverse weather delays due to precipitation and temperature is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities. Wind is not considered in the Monthly Anticipated Adverse Weather Calendar Day Schedule.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4	4	4	4	6	4	3	3	4	4	3	4

c. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day.

The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph "b", above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)."

1.3 WORK RESTRICTIONS

1.3.1 Working Hours

Working hours shall be Monday through Friday, 7 a.m. - 5 p.m.

1.4 UTILITIES

1.4.1 Payment for Utility Services (FAR 36.303(C)(6))

Water, gas, and electricity are available from Government-owned and operated systems and will be charged to the Contractor at rates as provided in Contract Clause 52.236.14 AVAILABILITY AND USE OF UTILITY SERVICES.

1.4.2 Outages

The Contractor shall coordinate all requests for utility outages with the Contracting Officer in writing 14 days prior to date

of requested outage:

a. Water, gas, steam, and sewer outages shall be held to a maximum duration of 4 hours unless otherwise approved in writing.

b. Electrical outages shall have a maximum duration of 4 hours.

1.5 STREET CLOSINGS

The Contractor shall coordinate all requests for street closings with the Contracting Officer in writing 14 days prior to date of requested outage:

a. One lane traffic shall be maintained at all times (except that a total closing may be allowed for specific 8-hour periods).

b. The final street repair shall be completed within 14 days after the start of any street crossing. Any part of the street returned to service prior to final repair shall be maintained smooth with hot-mix cold-lay surface course.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION 01420

BASIC STORMWATER POLLUTION PREVENTION PLAN
AM #0001 and AM #0002 and AM #0003

PART 1 GENERAL

1.1 SUMMARY

This Section provides a basic Stormwater Pollution Prevention Plan (SWPPP) for a National Pollutant Discharge Elimination System (NPDES) General Permit.

1.2 PROJECT IDENTIFICATION AND NOTES

PROJECT TITLE: Soldier Service Center

LOCATION: FORT HOOD, TEXAS

NOTE 1: General Permit for Storm Water Discharges from Construction Sites is authorized by the Clean Water Act and is regulated by guidance published in the Federal Register, Volume 63, Number 128, July 6, 1998.

NOTE 2: Under the National Pollutant Discharge Elimination System (NPDES), all construction sites 5.0 acres in size or larger are required to obtain a General Permit for Storm Water Discharges from Construction Sites. Detailed guidance to Storm Water Pollution Prevention Plan (SWPPP) and Best Management Practices (BMP) is available in the Environmental Protection Agency document EPA-832-R-92-005 titled "Storm Water Management for Construction Activities."

NOTE 3: To fully comply with the regulation, the Fort Worth District and the construction Contractor will each prepare a SWPPP, and file for a separate Notice of Intent (NOI). The construction Contractor shall file the Notice of Termination (NOT) after final site stabilization and provide a copy of the NOT to Fort Worth District (EV-EE) for filing with EPA. The Contractor shall use the basic SWPPP to prepare the Contractor's detailed SWPPP.

1.3 PROJECT DESCRIPTION

The new soldier service center shall have administrative areas, auditoriums, space allocated solely for the use of computers, conference rooms, record storage, dental treatment area, library, shipping and receiving area. Other support facilities shall include utilities, electric services (HVAC), information system, fire protection and alarm systems. Site improvement shall include parking area, traffic signal, pavement, pedestrian overpass, side walks, and storm drainage system.

The construction activities shall include establishing storm drainage controls; site demolition; clearing and grubbing; grading; concrete and asphalt pavement; excavation, trenching and backfill for utilities; fencing; landscaping. Prior to renovation and demolition of existing structures, the regulated materials such as asbestos containing material (ACM), and other regulated material shall be removed.

The new facility site occupies approximately 12.16 acres and all of which shall be disturbed. The demolition sites are adjoining and occupy approximately 3.04 acres and all of which shall be disturbed. The total project disturbed area is approximately 15.2 acres.

1.4 STANDARD INDUSTRIAL CLASSIFICATION (SIC)

The construction project has the following SIC codes in accordance with the Standard Industrial Classification Manual published by the Office of Management and Budget (OBM).

A. 1542 General Contractors - Non-Residential Building, other then Industrial Buildings and Warehouses (i.e. administrative buildings).

B. 1771 Concrete Work (includes asphalt, i.e. access drives and parking lots, culvert construction).

C. 1623 Water, Sewer, Pipeline, and Communications and Power Line Construction.

D. 9711 National Security (a general category for military facilities).

1.5 LOCATION

The project location is at Fort Hood, Texas. A portion of the west wing new soldier service center is in Coryell County, majority of the facility and the parking areas is in Bell County. The demolition site is in Bell County. The new facility site is located west of Hood Road, north of Battalion Avenue, and south of Old Ironside Avenue (previously Central Avenue). The demolition site is located east of Hood Road and south of Headquarter Avenue. The latitude and longitude of the new facility is N31 degrees 08 minutes 29 seconds and W97 degrees 46 minutes 01 seconds, respectively. The latitude and longitude of the demolition site is N31 degrees 08 minutes 15 seconds and W97 degrees 45 minutes 54 seconds, respectively.

1.6 RECEIVING WATERS

Surface runoff flows southeast to South Nolan Creek. The watershed flows east to Nolan River and then to Leon River.

PART 2 SITE DESCRIPTION

2.1 EXISTING CONDITIONS

The site for the Phase 1 work (new soldier service center) is currently vacant. The vacant site is located south of Old Ironside Avenue, north of 1800 Block structures, and between 47th Street and 48th Street. Majority of the site for Phase 2 work is currently occupies by buildings (1800 Blocks). The site has approximately 6 to 8 percent grade. Storm runoff drains east into the existing storm drainage system (reinforced concrete pipes or RCP) flowing south. Site runoff coefficient (C) is approximately 0.68 to 0.72.

Storm runoff at off site demolition work (Bid Option No.1) drains into existing storm drainage system (through curb inlets and RCP).

2.2 FUTURE CONDITIONS

After completion of the new soldier service center, site drainage sheet flows to curb and surface inlets, and through new storm sewers into existing storm drainage pipes north of the site (on Ironside Ave.). The parking areas are graded to sheet flow southeast and southwest. Storm drainage from the southeast side of the parking area empties into existing storm drainage system, south of the site. Site drainage from southwest side of the parking area outfall via a headwall to a grass lined drainage swales, on the southwest side the new 50th Street.

Storm drainage at demolition site shall not change after completion of work.

2.3 CONSTRUCTION PHASING

The project construction is anticipated to begin in August 2000 and complete in August 2002, respectively. The project Phase 1 work includes constructing the new soldier service center, 50th street, demolishing existing asphalt pavement and constructing new traffic control. The project Phase 2 work includes constructing parking areas serving the center and access road. The Base Bid of this project shall include Soldier Service Center. Currently, the 1800 Block wood structures occupies the future site of Phase 2 construction work (access road and parking area). These structures shall be demolished under other contract. The Contractor shall verify bid options to be executed, construction phasing requirements, and sequence of construction activities. The bid options for this project includes:

Bid Option No.1 - Off Site Demolition (Buildings 107, 108, and 134, including associated pavement and utilities)

Bid Option No.2 - Pedestrian Bridge that crosses Hood Road

Bid Option No.3 - New Traffic Signals (at the intersection of Battalion Avenue and 50th Street)

Bid Option No.4 - 300 Space POV Parking **[Am #0003]** Area with Street Lights (northwest of Hood Road and Battalion Avenue intersection)

Bid Option No.5 - Landscaping Irrigation System

[AM #0003]
Bid Option No.6 - Additional Landscaping (Trees)

Bid Option No.7 - Remove All Utility Lines Shown to be Capped and Abandoned on Sheet Nos. C6 and C7

Major Construction Activities at the new facility site include:

A. Establish erosion and sediment structural controls.

B. Clearing and demolition - Removing small brush, concrete curb and gutter, and miscellaneous items.

C. Site excavation and grading - Site drainage via sheet flow to storm water drainage system.

D. Construction of utilities and paving.

E. Site stabilization per paragraphs TEMPORARY STABILIZATION and PERMANENT STABILIZATION.

Major Construction Activities for Building Demolition include:

A. Establish erosion and sediment structural controls around existing curb and surface inlets at or in proximity of disturbed areas.

B. Removal, recycling, or disposal of regulated materials prior to demolition.

C. Site stabilization per paragraph PERMANENT STABILIZATION.

2.4 SOILS DATA

The following soils information is from the Soil Survey of Coryell County, Texas, issued March 1977, by the United States Department of Agriculture, Soil Conservation Service.

The site contains one soil type. The Topsy-Urban land complex association is characterized by deep and gently sloping land with slopes ranging from 3 to 8 percent, with an average slope of 4 percent. Typically, the surface layer is dark grayish brown clay loam and is approximately 7 inches deep. The subsoil measures approximately 22 inches and is grayish brown clay loam containing calcium carbonate and shale fragments. The underlying material consists of stratified layers of marl and shale. This soil type is generally well drained; however, permeability is moderately slow and occurs at the rate of 0.6 to 2.0 inches per hour. Availability of water is medium. Runoff is medium to rapid, and erosion is severe. The root zone is easily penetrated by plant roots. Unified Soil Classification of this soil type is C. Potential for shrink-swell is moderate. Soil reaction (pH) ranges from 7.9 to 8.4.

2.5 DRAWINGS

The drawing sheet no. C1 depicts the haul route, project location for the new soldier service center, parking areas, access roads, and the off site demolition (Bid Option No.1). The drawing sheet no. C2 depicts the project base bid and bid options 2, 3 and 4. The drawing sheet no. C8 depicts Phase 1 and Phase 2 construction work. The drawing sheet nos. H4, H5,& H6 are Erosion and Sediment Control Plans. Structural Control Details are shown on drawing sheet no. H7.

PART 3 EROSION AND SEDIMENT CONTROLS

3.1 TEMPORARY STABILIZATION

Temporary stabilization is required when construction activities cease for periods greater than 21 days, or when there are contract delays in the turfing operation, a quick cover shall be required to prevent erosion, or when seasonal conditions preclude immediate permanent stabilization measures, the Contractor shall provide temporary soil stabilization, as soon as practicable, for all unpaved, graded, and disturbed portions of the site. Reference Section 02940 - MULCHING FOR EROSION CONTROL for a recommended method.

3.2 PERMANENT STABILIZATION

Permanent soil stabilization shall be initiated 14 days after construction activities have ceased. All unpaved, graded, and disturbed areas within the limit of erosion and sediment control resulting from the Contractor's construction activities shall receive turfing treatment in accordance with Section 02933 - ESTABLISHMENT OF TURF.

3.3 TEMPORARY SEDIMENT BASINS

A temporary sediment basin is not attainable **[AM #0002].** Runoff from site does not drain to a common collection point.

3.4 STRUCTURAL CONTROLS

The Contractor shall use silt fence, staked hay bales, rock check dam, and sand bag berm to prevent soil erosion at the construction site. Structural controls shall be established at the limit of erosion and sediment control, drainage swales, curb and surface inlets, culverts and headwalls, construction entrance/egress, Contractor's staging area, stockpiled and excavated material areas. Structural controls shall be established at existing surface and curb inlets at or in proximity of the demolition structures.

PART 4 STORM WATER MANAGEMENT CONTROLS

4.1 RUNOFF COMPUTATIONS

The runoff rate at the project site shall increase after facility completion. The 10-year frequency storm event, storm duration of 30 minutes, rainfall intensity of 4.3 inches per hour (in/hr), and runoff coefficients shall range from 0.72 to 0.96.

4.2 OUTFALL VELOCITY DISSIPATION DEVICES

The outfall velocity dissipation devices are not required because site runoff is discharged to the existing storm drainage system.

PART 5 BEST MANAGEMENT PRACTICES (BMP) DURING CONSTRUCTION

The Contractor, or its subcontractors, shall be responsible to minimize pollution of storm water runoff. The Contractor shall discuss BMP in detailed SWPPP. They shall comply with the BMP to minimize stormwater pollution.

5.1 SOLID WASTE MATERIALS

Solid waste materials (trash and construction debris) shall be placed in covered and appropriate waste containers. Waste containers shall be emptied regularly; they shall not be allowed to overflow. The disposal area of excavated material from project construction shall not be utilized for waste disposal. Routine janitorial service shall be provided for all construction buildings and surrounding grounds. No construction waste materials, including concrete, shall be buried or otherwise disposed of on-site. All site personnel shall be briefed on the correct procedures for solid waste disposal.

5.2 HAZARDOUS, SPECIAL AND REGULATED WASTE

All hazardous waste shall be handled, stored, and disposed in accordance with all Federal, State, and local regulations and prior to all other construction activities. Chemical waste shall be stored in clearly labeled, corrosion-resistant containers, and stored in designated areas before removal from the site. Materials in excess of job requirements shall not be stored on-site. All site personnel shall be briefed on the correct procedures for hazardous waste disposal. Special waste from asbestos-containing materials (ACM) shall be managed per specification section ASBESTOS ABATEMENT prior to building demolition. All buildings to be demolished under this contract shall require removal of items containing regulated materials in accordance with specification section REMOVAL, RECYCLING, AND DISPOSAL OF REGULATED MATERIAL. These items shall include fluorescent light tubes, light ballasts, fire extinguishers, thermostats, smoke detectors, lighted exit signs, and emergency light batteries, etc.

5.3 SANITARY WASTE

On-site sanitary facilities shall be established. Facility location, design, maintenance, and waste collection practices shall be in accordance with local regulations.

5.4 OFF-SITE VEHICLE TRACKING AND DUST

The Contractor shall describe practices to keep vehicles from tracking soils from the project construction, material borrow and disposal sites. Describe practices for dust control (i.e. light bituminous treatment in accordance with Section 01410, paragraph TEMPORARY EXCAVATION AND EMBANKMENTS). The Contractor shall describe practice in hauling construction material or debris to avoid their loss during transport (i.e. open-bed vehicles shall be covered or otherwise stabilized).

Temporary parking area(s) to be used 30 calendar days or more for the Contractor's equipment or personal vehicles shall be paved with temporary asphalt per specification and it shall be removed by the Contractor upon project completion. The contractor shall require to stabilize the disturbed area in accordance with paragraph PERMANENT STABILIZATION.

5.5 FERTILIZERS

If fertilizers are required by this project, they shall be applied in accordance with the manufacturer's recommendations, in the stated amounts per Section 02940 - MULCHING FOR EROSION CONTROL, and only when weather conditions are appropriate.

5.6 CONSTRUCTION VEHICLE MAINTENANCE AND REPAIR

Specific areas shall be designated for equipment maintenance and repair to minimize potential impact on storm runoff. Locations shall be chosen to minimize potential impacts on receiving streams and waterways. These locations shall be approved by the Contracting Officer, and structural controls shall be provided. All construction vehicles shall be regularly inspected for leaks and receive regularly scheduled maintenance to reduce the potential for leaks.

5.7 VEHICLE FUELING

Vehicle fueling at project site shall be conducted in accordance with good safety practices to reduce the potential for leaks and spills. Only properly constructed fuel containers shall be used on-site and shall be labeled and stored in accordance with applicable Federal, state, and local codes. Washing and curing waters shall be drained into a retention basin constructed by the Contractor. It shall be cleaned up by the Contractor, to the satisfaction of the Contracting Officer, after project completion.

5.8 WATER SOURCE

Water used at site to establish and maintain grass, to control dust, and for other construction purposes shall be from a public water supply or private well approved by the Contracting Officer, state or local health department. Backflow prevention valve shall be installed to prevent cross contamination to water supply line at the tie-in location.

PART 6 TIMING OF CONTROLS AND ACTIVITIES.

The Contractor shall perform the following control activities:

(1) stabilize construction entrance at the new facility,
(2) install silt fence at the limit of erosion and sediment control,
(3) install hay bale dikes at existing curb and surface inlets at or in proximity to the renovated site (Fire Station) and the demolition area,
(4) establish temporary and permanent stabilization per PART 3 EROSION AND SEDIMENT CONTROL this section,
(5) backfill utility trenches in a timely manner to minimize erosion,
(6) place natural or synthetic fiber met on excavated and stockpiled material
(7) inspect and maintain erosion and sediment structural control structures (reference GENERAL NOTES on Erosion and SEDIMENT CONTROL PLAN 1)
(8) remove all structural controls after approval from Contracting Officer

PART 7 COMPLIANCE WITH FEDERAL, STATE, AND LOCAL REGULATIONS

This project is in compliance with the National Environmental policy Act of 1969, as amended. The construction project does not significantly alter land use. **[AM #0003]** No hazardous materials have been stored in the surrounding area and there are no underground storage tanks associated with the site. There has been no petroleum, oil, or lubricants stored in the project area. The site is not in a threatened and endangered bird habitat and there are no significant archeological resources. There are no floodplain, agricultural land, or wetland impacts associated with this project construction. In accordance with **[AM 0003]** the Record of Consideration (REC), dated June 2000, has determined that the project site is qualified for categorical exclusion No. A-7, Appendix A, AR-200-2.

The Contractor shall comply with all applicable Federal environmental statutes, which include a provision to observe state, local and environmental regulations during construction.

PART 8 MAINTENANCE AND INSPECTION PROCEDURES

The Contractor shall conduct inspection of erosion and sediment structural controls at each construction area. All pollution prevention structural

controls measures shall be inspected, the specific criteria and frequency includes:

(1) During rainfall season - once every seven (7) days and within 24 hours after any storm event greater than 13mm (0.5 inches).

(2) During seasonal dry periods where average rainfall is less than 500mm (20 inches)- once a month and within 24 hours after any storm event greater than 13mm (0.5 inches).

(3) When sites have been temporarily or final stabilized - once a month.

The inspector shall thoroughly understand the requirements of the Contractor's SWPPP and shall have a basic knowledge of the engineering principles for reducing runoff pollution.

Temporary stabilization or grading shall be inspected for erosion and soil loss from the site. Temporary erosion control measures shall be inspected for bare spots and washouts. Discharge points shall be inspected for signs of erosion or sediment. Locations where vehicles enter and leave the site shall be checked for signs of off-site sediment tracking, including erosion control structure at material borrow, disposal, excavated, and stockpiled areas. The BMP and pollution control maintenance procedures shall be reviewed for adequate erosion control by the Contractor during construction. All deficiencies shall be recorded in the Inspection and Maintenance Report posted at the project bulletin board and submit to the Contracting Officer after each inspection. The Contractor shall implement corrections to these problems within seven (7) calendar days after inspection and revise the SWPPP. After final stabilization has been achieved, the Contractor shall inspect the site once a month until final inspection and project acceptance by the Contracting Officer.

PART 9 MATERIAL INVENTORY

All materials or substances brought on-site during construction shall have a Material Safety Data Sheet (MSDS) available to the Contracting Officer. These materials include concrete, paints, sealants, petroleum-based products, cleaning solvents, fertilizers, tar, asphalt, and steel reinforcing bars. The list of materials shall be stated in the Contractor's detailed SWPPP.

PART 10 NON-STORM WATER DISCHARGE

Non-storm water discharge shall not be allowed during construction of the project in accordance with 63 FR 128, July 6, 1998, except for emergency fire-fighting flows and other flows listed in the following:

(1) vehicle wash water if detergents are not used,
(2) dust control runoff in accordance with permit conditions,
(3) fire Hydrant flushing,
(4) potable water sources including water line flushing
(5) uncontaminated ground water resulting from dewatering activities
(6) irrigation drainage
(7) routine external building wash down which does not use detergent
(8) wash water from pavement with no spilled or leaked toxic or hazardous material and no detergent
(9) air conditioning condensate

(10) spring water
(11) foundation or footer drain water where flows are not contaminated with process material such as solvent

In addition, any spill of a hazardous substance in excess of reporting quantities shall be reported as required under 40 CFR 110. Spill containment, notification, and clean-up in accordance with applicable Federal, State, and Local regulations, and to the satisfaction of the Contracting Officer shall be required.

PART 11 CONTRACTOR COMPLIANCE

The Contractor shall use this basic SWPPP to prepare a detailed SWPPP that includes both narrative and drawings (Erosion and Sediment Control Plans). The detailed SWPPP shall state the following as a minimum: (1) the project start and completion dates, (2) bid options to be executed with the project, (3) construction phasing requirements, sequence of construction activities, and pollution control measures, (4) discussion of the BMP and implementation during project execution, (5) identify the list of materials brought on site, (6) runoff computation of each drainage area (see paragraph 4.1), and (7) revised Erosion and Sediment Control Plans to include all locations that require structural controls (i.e. site entrance and exit, staging, stockpiled and borrowed areas, and disposal area for both on site and off site locations), and the type of storm control structures.

Being responsible for the daily operations at the construction site and inspection of the established controls in accordance with the NPDES permit requirements. The Contractor shall submit the detailed SWPPP (including the revised Stormwater Control Plans), and a Notice of Intent (NOI) for the Stormwater Discharges Associated with Industrial Activity under NPDES General Permit to EPA. The NOI (EPA Form 3510-6) shall be submitted no later than 48 hours before start of construction. A separate NOI is required for each construction contract or each phase of the construction activities. The mailing address for NOI submittal is:

Stormwater Notice of Intent (4203),
USEPA, 401 M Street, SW
Washington, D. C. 20460

The Contractor's detailed SWPPP (including the revised Stormwater Control Plans) and a copy of submitted NOI shall be provided to the Contracting Officer before start of construction. A copy of the U.S. Army Corps of Engineers NOI (obtained from the Contracting Officer), the Contractor's NOI, and a brief project description shall be posted on the project bulletin board. The Contractor's detailed SWPPP shall be kept on-site at all times. During construction, the Contractor shall perform work as required per paragraph, MAINTENANCE AND INSPECTION PROCEDURES in this section.

No later than 10 working days after acceptance of final stabilization, the Contractor shall submit the Notice of Termination (NOT), EPA Form 3510-7 to EPA. Two copies of the submitted NOT shall be provided to the Contracting Officer's project file. EPA Forms are available on web site at http://www.epa.gov/earth1r6/6en/w/forms.htm. It is not required but the Contractor may choose to provide the NOT to the Environmental Division of

the Fort Worth District. The Environmental Division shall file both the USACE and Contractor's NOT to EPA to facilitate project closeout. The mailing address for the Contractor's prepared and signed NOT is:

ATT: Dr. Hank Jarboe,
CESWF-EV-EE (RM 3A14)
U.S.Army Corps of Engineers
819 Taylor Street
Fort Worth, TX 76102-0300

PART 12 ATTACHMENTS

12.1 OWNER CERTIFICATION

OWNER CERTIFICATION
FOR
SOLDIER SERVICE CENTER
FORT HOOD, TEXAS

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

MICHAEL J. MOCEK, P.E.
DEPUTY DISTRICT ENGINEER

Date Certified:_____

Attachments:

Sheet No.	Title
C1	PROJECT LOCATION MAP
C2	BASE BID + BID OPTIONS 2,3,&4
C8	PHASING PLAN - NEW WORK
H4	EROSION AND SEDIMENT CONTROL PLAN 1
H5	EROSION AND SEDIMENT CONTROL PLAN 2
H5	EROSION AND SEDIMENT CONTROL PLAN 3
H7	EROSION AND SEDIMENT CONTROL STRUCTURAL DETAILS

12.2 STORMWATER POLLUTION PREVENTION PLAN

STORMWATER POLLUTION PREVENTION PLAN

INSPECTION AND MAINTENANCE REPORT

INSPECTOR:_____ DATE:_____

INSPECTOR'S
QUALIFICATION:_____

_____

_____

_____

_____

DAYS SINCE LAST RAINFALL:_____ AMOUNT OF LAST RAINFALL:_____INCHES

STABILIZATION MEASURES

AREA	DATE SINCE LAST DISTURBANCE	DATE OF NEXT DISTURBANCE	STABILIZED? (YES/NO?)	STABILIZED WITH	CONDITION

_____

STABILIZATION REQUIRED:
_____

_____

TO BE PERFORMED BY:_____ ON or BEFORE:_____

STORMWATER POLLUTION PREVENTION PLAN

INSPECTION AND MAINTENANCE REPORT

OTHER CONTROLS - STABILIZED CONSTRUCTION ENTRANCE

IS MUCH SEDIMENT TRACKED ONTO THE ROAD?	ARE DUST AND SEDIMENT CONTROL MEASURES WORKING?	DOES ALL TRAFFIC USE THE STABILIZED ENTRANCE TO THE SITE?	ARE ASSOCIATED DRAINAGE STRUCTURES WORKING?

MAINTENANCE REQUIRED FOR CONSTRUCTION ENTRANCE:

TO PERFORMED BY:_____ ON OR BEFORE:_____

OTHER CONTROLS - DEVELOP SITE SPECIFIC TABLES AS NEEDED

FOR ALL STABILIZATION MEASURES, STRUCTURAL, AND NON-STRUCTURAL CONTROLS

CHANGES/CORRECTIONS REQUIRED IN POLLUTION PREVENTION PLAN:

REASONS FOR CHANGES:

INSPECTOR'S SIGNATURE:_____ DATE:_____

STORMWATER POLLUTION PREVENTION PLAN

INSPECTION AND MAINTENANCE REPORT

MAINTENANCE REQUIRED FOR SEDIMENT BASIN(S):

_____
_____
_____
_____
_____

TO BE PERFORMED BY:_____ ON OR BEFORE:_____

STRUCTURAL CONTROLS - SILT FENCE(S)

FROM	TO	IS THE BOTTOM OF THE FABRIC STILL BURIED?	IS THE FABRIC IN GOOD CONDITION?	HOW DEEP IS THE SEDIMENT?

_____

MAINTENANCE REQUIRED FOR THE SILT FENCE (S):

_____
_____
_____
_____
_____

TO BE PERFORMED BY:_____ ON OR BEFORE:_____

STORMWATER POLLUTION PREVENTION PLAN

INSPECTION AND MAINTENANCE REPORT

STRUCTURAL CONTROLS - EARTH DIKES(S)

FROM	TO	IS DIKED STABILIZED?	IS THERE EVIDENCE OF WASH-OUT OR OVERTOPPING?

MAINTENANCE REQUIRED FOR THE EARTH DIKE(S):

_____
_____
_____
_____
_____

TO BE PERFORMED BY:_____ ON OR BEFORE:_____

-- End of Section --

SECTION 04200

MASONRY
AM# 0003

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.

ACI INTERNATIONAL (ACI)

ACI SP-66	(1994) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1997a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 67	(1998a) Sampling and Testing Brick and Structural Clay Tile
ASTM C 90	(1998) Load bearing Concrete Masonry Units
ASTM C 91	(1998) Masonry Cement
ASTM C 129	(1997) Nonloadbearing Concrete Masonry Units
ASTM C 140	(1998b) Sampling and Testing Concrete Masonry Units
ASTM C 216	(1998) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(1997ae1) Mortar for Unit Masonry
ASTM C 476	(1998) Grout for Masonry
ASTM C 494	(1998) Chemical Admixtures for Concrete
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation

ASTM C 641	(1982; R 1991) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(1997) Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
ASTM C 780	(1996) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 1019	(1989a; R 1998) Sampling and Testing Grout

AM# 0001

ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 2000	(1998c) Rubber Products in Automotive Applications
ASTM D 2240	(1997el) Rubber Property - Durometer Hardness
ASTM D 2287	(1996) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	(1998) Fire Tests of Building Construction and Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Clay or Shale Brick; GA. **AM# 0001 Concrete masonry units; GA**

Manufacturer's descriptive data.

SD-04 Drawings

Masonry Work; GA.

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. Drawings shall be provided showing the location and layout of glass block units. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during

construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-08 Statements

Cold Weather Installation; GA.

Cold weather construction procedures.

SD-09 Reports

Efflorescence Test; GA. Field Testing of Mortar; GA. Field Testing of Grout; GA. Prism tests; GA. Masonry Cement; GA. Fire-rated CMU; GA.

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection; GA.

Copies of masonry inspector reports.

SD-13 Certificates

Clay or Shale Brick; FI0. Concrete Masonry Units (CMU); FIO. Control Joint Keys; FIO. Anchors, Ties, and Bar Positioners; FIO. Expansion-Joint Materials; FIO. Joint Reinforcement; FIO. Reinforcing Steel Bars and Rods ; FIO. Masonry Cement; FIO. Mortar Coloring; FIO. **AM# 0001** Precast Concrete Items; FIO. Mortar Admixtures; FIO. Grout Admixtures; FIO. **AM# 0001**

Certificates of compliance stating that the materials meet the specified requirements.

AM# 0001

SD-14 Samples

Concrete Masonry Units (CMU); GA. **AM# 0001** Clay or Shale Brick; GA.

Anchors, Ties, and Bar Positioners; GA.

Two of each type used.

Expansion-Joint Material; GA.

One piece of each type used.

Joint Reinforcement; GA.

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

AM# 0001
ues.

Portable Panel; GA.

One panel of clay or shale brick, 2 feet by 2 feet, containing approximately 24 brick facings to establish range of color and texture.

1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 8 feet long by 6 feet high.

1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, **AM# 0001** CMU control joints, brick expansion joints, **AM# 0001** flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 2 foot by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring

up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90 when delivered to the jobsite. In addition, glass block units shall be stored with their finish surfaces covered. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

AM# 0001

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Grade SW shall be used for brick in contact with earth or grade and for all exterior work. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Clay or Shale Brick

Solid clay or shale brick shall conform to ASTM C 216, Type FBS. Brick size shall be modular and the nominal size of the brick used shall be 3 5/8 inches thick, 2 1/4 inches wide, and 7 5/8 inches long. Minimum compressive strength of the brick shall be 2500 psi.

2.3 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I, medium weight. Cement shall have a low alkali content and be of one brand.

2.3.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.3.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

AM# 0001

AM# 0001

2.4 PRECAST CONCRETE ITEMS

AM# 0001 Lintels**AM# 0001 and** splash blocks and door sills shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 4,000 psi minimum conforming to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inchshall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 pounds per square inch for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or

longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. **AM# 0001** Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.4.1 Lintels

Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure.

2.4.2 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.5 MORTAR

Mortar shall be Type S in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source. Coarse aggregate shall meet gradation requirements of ASTM C 404 and fine aggregate shall comply with requirements of ASTM C 144.

2.5.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

2.5.2 Coloring

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color as indicated in Section **AM# 0001 09915** ,- COLOR SCHEDULE. Mortar coloring shall not exceed 3 percent of the weight of cement for carbon black and ten percent of the weight of cement for all other pigments. Mortar coloring shall be chemically inert, of finely ground lime proof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement.

2.6 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Grout shall be used subject to the limitations of Table III. Proportions shall not be

changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Coarse aggregate shall meet gradation requirements of ASTM C 404 and fine aggregate shall comply with requirements of ASTM C 144.

2.6.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

2.6.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.7 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

2.7.1 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

2.7.2 Adjustable Anchors

Adjustable anchors shall be 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.7.3 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.8 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between cross wires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement *may be furnished with adjustable wall tie features.*

2.9 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.10 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000 or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inchthick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.11 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07900JOINT SEALING.

2.12 FLASHING

Flashing shall be as specified in Section 07600 SHEET METALWORK, GENERAL.

2.13 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum grill type vents designed to prevent insect entry with maximum air entry. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.

AM# 0001 2.20 MORTAR COLLECTION DEVICE

Mortar cillection device shall be manufactured of high density polyethylene, nylon or recycled polester designed to carch mortar droppings above the level of the weep holes. The collection device shall allow water

and air to move through the device to the weep holes.

PART 3 EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F.

b. Air Temperature 32 to 25 Degrees F.Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 degrees F to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 32 degrees F to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature 25 Degrees F to 20 Degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature 20 Degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

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3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a non furrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythes from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

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3.2.2.1 Field compressive strengths of 1800 psi will be required.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	1/4 inch
Plus	1/2 inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall

plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

3.2.8.2 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and

other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.12 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 4 inches above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 4 inch nominal thick units shall be tied to intersecting partitions of 4 inch units, 5 inches into partitions of 6 inch units, and 7 inches into partitions of 8 inch or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 4 inches thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 4 inches of coarse aggregate or 10 inches of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Weep holes shall be provided not more than **AM# 0001** 16 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep

holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 MORTAR COLLECTION DEVICES

Mortar collection devices shall be installed at all locations where weep holes are required, as stated above.

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3.7 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.8 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.8.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inchshall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.8.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.9 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be

placed to provide not less than 5/8 inch cover to either face of the unit.

3.10 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flow outs, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.10.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.10.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.10.3 Grout Holes and Cleanouts

3.10.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.10.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.10.4 Grouting Equipment

3.10.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.10.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.10.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.10.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.10.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and

placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:
a) The required minimum dimensions of total clear areas given in the table above;
b) The width of any mortar projections within the space;
c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inchor greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.11 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using mortar to fill the head joint special control-joint units sash jamb units with control joint key open end stretcher units in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07900 JOINT SEALING. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

3.12 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints and concrete masonry veneer joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.13 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 10 feet and installed with a 1/4 inch gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4 feet, unless limited by wall configuration.

3.14 LINTELS

3.14.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.14.2 Precast Concrete and Steel Lintels

Precast concrete and steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings.

3.15 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.16 ANCHORAGE TO STRUCTURAL STEEL

3.16.1 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

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3.18 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.19 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashing shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.19.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.19.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 1/2 cup trisodium phosphate and 1/2 cup laundry detergent to one gallon of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning

product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.20 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.21 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.22 TEST REPORTS

3.22.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.22.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days.

3.22.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

-- End of Section --

SECTION 06100

ROUGH CARPENTRY
AM# 0003

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 FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T01	(1991; Supple 1993; Addenda Apr 1997; Supple T02) National Design Specification for Wood Construction
AF&PA T11	(1988) Manual for Wood Frame Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM C 79/C 79M	(1997) Treated Core and Nontreated Core Gypsum Sheathing Board
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Heat Flow Meter Apparatus
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1289	(1998) Faced Rigid Cellular

	Polyisocyanurate Thermal Insulation Board
ASTM E 84	(1998e1) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 154	(1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM F 547	(1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Base Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2	(1995) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C9	(1997) Plywood - Preservative Treatment by Pressure Processes
AWPA M4	(1996) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(1997) Standards for Waterborne Preservatives

CALIFORNIA REDWOOD ASSOCIATION (CRA)

CRA RIS-01-SS	(1997) Standard Specifications for Grades of California Redwood Lumber

CODE OF FEDERAL REGULATIONS (CFR)

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1	(1996) Voluntary Product Standard - Construction and Industrial Plywood
DOC PS 2	(1992) Performance Standards for Wood-Based Structural-Use Panels

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(1994) Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(1997) Standard Grading Rules for Northeastern Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Specs	(1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB Rules	(1994; Supple 8 thru 11) Standard Grading Rules for Southern Pine Lumber

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB Std 17	(1996; Supples VII(A-E), VIII(A-C)) Grading Rules for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA Grading Rules	(1995; Supple Nos. 1 thru 5) Western Lumber Grading Rules 95

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Nailers and Nailing Strips; FIO.

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-13 Certificates

Grading and Marking; FIO.

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Insulation; FIO.

Certificate attesting that the cellulose, perlite, glass and mineral fiber,glass mat gypsum roof board, polyurethane, or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity. Laminated timber shall be handled and

stored in accordance with AITC 111 or APA EWS R540C.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

2.1.1 Grading and Marking

2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

2.1.1.2 Plywood and Other Sheathing Products

Materials shall bear the grademark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Except for plywood and wood structural-use panels, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil. Except as specified for all-heart material of the previously mentioned species, the following items shall be treated:

a. Wood members in contact with or within 18 inches of soil.

b. Wood members in contact with water.

c. Wood members exposed to the weather including those used in builtup roofing systems or as nailing strips or nailers over fiberboard or gypsum-board wall sheathing as a base for wood siding.

d. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.

e. Wood members in contact with concrete that is in contact with soil or water or that is exposed to weather.

f. All other blocking not covered above.

2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPA C2 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use.

2.1.3.2 Plywood

Plywood shall be treated in accordance with AWPA C9 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use.

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

a. Treated and Untreated Lumber Except Roof Planking: 4 inches or less, nominal thickness, 19 percent maximum. 5 inches or more, nominal thickness, 23 percent maximum in a 3 inch perimeter of the timber cross-section.

b. Roof Planking: 15 percent maximum.

c. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 Sheathing

Sheathing shall be gypsum board or plywoodas indicated.

2.1.5.1 Gypsum Sheathing Board

Glass mat gypsum sheathing shall conform to ASTM C 79/C 79Mand ASTM C 1177/C 1177M. Gypsum board shall conform to ASTM C 79/C 79M, **AM# 0001 5/8**1, 4 feet wide with straight edges for supports 16 inches on center without corner bracing of framing or for supports 24 inches on center with corner bracing of framing; 2 feet wide with V-tongue and groove edges for supports 16 or 24 inches on center with corner bracing of framing.

2.1.5.2 Plywood

Plywood shall conform to DOC PS 1, Exposure 1 (exterior grade glue), sheathing grade. Sheathing for roof **AM #0003** shall **AM# 0001 be 5/8 inch thick.AM #0003 Sheathing for roof shall be 3/4" Fire-Retardant Treated plywood and shall have an APA span rating of 40/20.**

2.1.6 Miscellaneous Wood Members

2.1.6.1 Nonstress Graded Members

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size (inch)
Bridging	1 x 3 or 1 x 4 for use between members 2 x 12 and smaller; 2 x 4 for use between members larger than 2 x 12.
Corner bracing	1 x 4.
Furring	1 x 2.
Grounds	Plaster thickness by 1-1/2.
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

2.1.6.2 Blocking

Blocking shall be standard or number 2 grade.

2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

2.2.3 Expansion Shields

Type and size best suited for intended use.

2.2.4 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T11. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an

adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T01. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.3 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown. R-values shall be determined at 75 degrees F in accordance with ASTM C 518. Insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing more than one percent asbestos will not be allowed.

2.3.1 Batt or Blanket

2.3.1.1 Mineral Fiber Batt

Mineral fiber batt shall conform to ASTM C 665, Type I unfaced insulation.

2.3.1.2 Mineral Fiber Blanket

Mineral fiber blanket shall conform to ASTM C 553, Type I, Class 6. Blankets shall be sized to suit construction conditions, resilient type for use below and above ambient temperature to 350 degrees F. Blankets shall have a factory applied vapor-barrrier facing on one side with 2 inch nailing tabs on both edges. Vapor barriers shall be fire retardant, high vapor transmission, and aluminum foil laminated to crepe paper type conforming to ASTM C 1136, Type II. Nominal density shall be 0.75 pcf.

2.3.2 Sill Sealer

Mineral wool, 1 inch thick and compressible to 1/32 inch, width of sill, designed to perform as an air, dirt, and insect seal in conformance with ASTM C 665, Type I.

2.3.3 Rigid Insulation

2.3.3.1 Polystyrene Board

Polystyrene board shall be extruded and conform to ASTM C 578, Type IV.

2.3.3.2 Polyurethane or Polyisocyanurate Board

Polyurethane or polyisocyanurate board shall have a minimum recovered material content of 9 percent by weight of core material in the polyurethane or polyisocyanurate portion. Unfaced preformed polyurethane shall conform to ASTM C 591. Faced polyisocyanurate shall conform to ASTM C 1289.

2.3.3.3 Glass Fiber or Insulation Board

Glass fiber or insulation board shall conform to ASTM C 612, Type 1A with a minimum recovered material content of 6 percent by weight of glass fiber core material.

2.4 VAPOR RETARDER

Vapor retarder shall be polyethylene sheeting conforming to ASTM E 154 or other equivalent material. Vapor retarder shall have a maximum vapor permeance rating of 0.5 perms as determined in accordance with ASTM E 96, unless otherwise specified.

PART 3 EXECUTION

3.1 INSTALLATION OF FRAMING

3.1.1 General

General framing shall be in accordance with AF&PA T11.Members shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Members shall be framed for passage of ducts. Members shall be cut, notched, or bored in accordance with applicable requirements of AF&PA T01 for the passage of pipes, wires, or conduits. Rafters, purlins, and joists shall be set with crown edge up. Framing shall be kept at least 2 inches away from chimneys and 4 inches away from fireplace backwalls. When joists, beams, and girders are placed on masonry or concrete, a wood base plate shall be positioned and leveled with grout. The joist, beam, or girder shall then be placed on the plate. When joists, beams, and girders are set into masonry or concrete, a pocket shall be formed into the wall. The joist, beam, or girder shall then be placed into the pocket and leveled with a steel shim.

AM# 0001 3.1.2 Blocking

Blocking shall be provided as necessary for application of toilet accessories, ADA grab bars, and wood trim items as specified, and other materials or building items as required. Blocking shall be cut to fit snugly between framing members and rigidly nailed there together.

3.2 INSTALLATION OF SHEATHING

3.2.1 Gypsum Board

Sheathing shall be applied with edges in light contact at joints and nailed in accordance with the manufacturer's approved instructions. Sheets 2 feet wide shall be applied horizontally with tongued edge up, with vertical joints over supports, and with vertical joints staggered. Sheets 4 feet wide shall be applied vertically, extended over top and bottom plates, and with all vertical and horizontal joints over supports.

3.2.2 Plywood and Wood Structural-Use Panels

Sheathing shall be applied with edges 1/8 inch apart at side and end joints, and nailed at supported edges at 6 inches on center and at intermediate supports 12 inches on center unless otherwise shown. Nailing of edges shall be 3/8 inchfrom the edges. Wall sheathing shall extend over top and bottom plates, and if applied horizontally the vertical joints

shall be made over supports and staggered. **AM# 0001** W Roof sheathing shall be applied with long dimension at right angles to supports, end joints made over supports, and end joints staggered.

3.2.3 Wood

Sheathing end joints shall be made over framing members and so alternated that there will be at least two boards between joints on the same support. Each board shall bear on at least three supports. Boards shall be nailed at each support using two nails for boards 6 inches and less in width and three nails for boards more than 6 inches in width. Roof sheathing shall not be installed where roof decking is installed.

AM# 000 3.3 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

3.3.1 Bridging

3.3.2 Blocking

Blocking shall be provided as necessary for application of siding, sheathing, subflooring, wallboard, and other materials or building items, and to provide firestopping. Blocking for firestopping shall ensure a maximum dimension of 8 feet for any concealed space. Blocking shall be cut to fit between framing members and rigidly nailed thereto.

3.3.3 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 18 inches on center and staggered. Beginning and ending nails shall not be more than 6 inches for nailer end. Ends of stacked nailers shall be offset approximately 12 inches in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM LPD 1-49.

3.3.4 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 16 inches on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

3.4 INSTALLATION OF TIMBER CONNECTORS

Installation of timber connectors shall conform to applicable requirements of AF&PA T01.

3.5 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the R-values

shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

3.6 INSTALLATION OF VAPOR RETARDER

Vapor retarder shall be applied to provide a continuous barrier at window and door frames, and at all penetrations such as electrical outlets and switches, plumbing connections, and utility service penetrations. Joints in the vapor retarder shall be lapped and sealed according to the manufacturer's recommendations.

3.7 INSTALLATION OF AIR INFILTRATION BARRIER

Air infiltration barrier shall be installed in accordance with the manufacturer's recommendations.

TABLE I. SPECIES AND GRADE

Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm
NHLA Rules					
	Cypress			X	
NELMA Grading Rules					
	Northern White Cedar				X
	Eastern White Pine	X			
	Northern Pine	X			
	Balsam Fir				X
	Eastern Hemlock-Tamarack				X
CRA RIS-01-SS					
	Redwood		X		
SCMA Specs					
	Cypress			X	
SPIB Rules					
	Southern Pine		X		
WCLIB Std 17					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Sitka Spruce	X			
	Mountain Hemlock	X			
	Western Cedar	X			
WWPA Grading Rules					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Idaho White Pine	X			
	Lodgepole Pine			X	
	Ponderosa Pine			X	
	Sugar Pine			X	

TABLE I. SPECIES AND GRADE

Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm
	Englemann Spruce			X	
	Douglas Fir South			X	
	Mountain Hemlock			X	
	Subalpine Fir			X	
	Western Cedar			X	

TABLE II. SPECIES AND GRADE

Wood Bumpers

Grading Rules	Species	No. 1	No. 2
NHLA Rules			
	Red Oak	X	
NELMA Grading Rules			
	Northern Pine		X
	Eastern Hemlock-Tamarack		X
SPIB Rules			
	Southern Pine	X	
WCLIB Std 17			
	Douglas Fir-Larch		X
	Hem-Fir		X
WWPA Grading Rules			
	Douglas Fir-Larch		X
	Hem-Fir		X
	Douglas Fir-South		X

-- End of Section --

SECTION 07510

BUILT-UP ROOFING
AM# 0003

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 C 208	(1995) Cellulosic Fiber Insulating Board
ASTM C 728	(1997) Perlite Thermal Insulation Board
ASTM C 1153	(1997) Location of Wet Insulation in Roofing Systems Using Infrared Imaging
ASTM C 1177/C 1177M	(1996) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 43	(1994) Coal Tar Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 227	(1998) Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 312	(1995a) Asphalt Used in Roofing
ASTM D 450	(1996) Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing
ASTM D 517	(1992) Asphalt Plank
ASTM D 1668	(1997a) Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D 1863	(1993; R 1996) Mineral Aggregate Used on Built-Up Roofs
ASTM D 2178	(1997) Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 2626	(1997b) Asphalt-Saturated and Coated

	Organic Felt Base Sheet Used in Roofing
ASTM D 3617	(1983; R 1994) Sampling and Analysis of New Built-Up Roof Membranes
ASTM D 3909	(1997) Asphalt Roll Roofing (Glass Felt) Surfaced With Mineral Granules
ASTM D 4022	(1994) Coal Tar Roof Cement, Asbestos Containing
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free
ASTM D 4601	(1998) Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4897	(1998) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825c	(1998) Approval Guide Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Inspection; FIO.

The inspection procedure for roofing installation, prior to the start of roofing work.

SD-13 Certificates

Bitumen; FIO. Felt; FIO. **AM #0003 Course Aggregates; FIO**

Certificate of compliance for aggregates per ASTM D 1863.

Certificates of Compliance for felts and bitumens.

Cants; FIO.

Certificate attesting that the fiberboard furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 STORAGE OF MATERIALS

Felts, fabrics, and roll roofing shall be kept dry before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer, and stored on end 1 level high. Felt rolls shall be maintained at a temperature above 50 degrees F for 24 hours immediately

before laying. Aggregate shall be kept dry as defined by ASTM D 1863.

1.4 WARRANTY

Manufacturer's 20 year, No Dollar Limit (NDL) warranty shall be provided for the roofing system. Warranty shall state that manufacturer shall repair or replace defective materials if the roofing system leaks or allows the insulation beneath the membrane to become wet during the period of the warranty. Warranty shall commence upon Government's acceptance of the work. Warranty shall not contain a provision requiring a documented owner maintenance program.

1.5 FIRE AND WIND UPLIFT REQUIREMENTS

The roofing system shall listed as a Class I roof deck and shall be rated Class 1-90 for wind uplift in FM P7825c.

PART 2 PRODUCTS

2.1 PRIMER

ASTM D 41 for asphalt roofing systems **AM# 0001** .

2.2 BITUMEN

2.2 Asphalt

ASTM D 312, Type III on slopes from 1/4 inch per foot up to and including 3 inches per foot; Type IV on slopes above 3 inches per foot. Bills of lading shall indicate the flash point and equiviscous temperature (EVT) or this information shall be shown on labels for each container of asphalt.

2.3 BITUMINOUS CEMENT

ASTM D 4586 for use with asphalt roofing systems

2.4 CANTS

Cants shall be made from **AM# 0001** treated fiberboard or perlite board not less than 3-1/2 inches high cut to reduce change in direction of the membrane to 45 degrees or less. **AM# 0001** . Perlite and fiberboard shall contain the highest practicable percentage of materials which have been recovered or diverted from solid waste (e.g., postconsumer waste), but not including material reused in a manufacturing process. Where two materials have comparable price and performance, the one having the higher recovered material content shall be selected. Fiberboard shall conform to ASTM C 208 with a minimum recovered material content of 80 percent, treated with sizing, wax or bituminous impregnation. Perlite board shall conform to ASTM C 728 with a minimum recovered material content of 23 percent of the expanded perlite portion of the board.

2.5 FELT

2.5.1 Base Sheet

Base sheet shall conform to ASTM D 4601, Type II, with no perforations.

2.5.2 Glass Roofing Felt

ASTM D 2178, Type IV or VI.

2.6 **AM# 0001 MODIFIED BITUMEN BASE FLASHING**

AM# 0001 Elastomeric, modified bitumen flashing sheet incorporating a flexible fiber glass/polyester composite mat in a blend of SBS rubber and asphalt. Sheet shall have a covering layer of ceramic-coated roofing granules.

2.7 NAILS AND FASTENERS

Nails and fasteners shall be an approved type recommended by the roofing felt manufacturer. Fasteners for steel deck shall conform to FM P7825c for Class I roof deck construction, to withstand an uplift pressure of 90 pounds per square foot.

2.8 AGGREGATE SURFACING MATERIALS

Crushed stone, gravel, or crushed slag conforming to ASTM D 1863. Subject to approval, other materials may be used when blended to the grading requirements of ASTM D 1863. Aggregate shall be light-colored and opaque.

2.9 WALKWAY SURFACES

2.9.1 Mineral Asphalt Plank

ASTM D 517, minimum 32" x 32" x 3/4" inch thick.

2.9.2 Modified Bitumen Board

Preformed board consisting of modified asphalt, reinforcements and fillers with a ceramic granule surface on both sides. Minimum 32" x 32" x 3/8" thick.

2.10 INSULATION

Insulation shall be fiberboard, **AM# 0001** expanded perlite, mineral fiber, or polyisocyanurate, as specified in Section 07220 ROOF INSULATION. Top layer shall be minimum 3/4 inch thick fiberboard, mineral fiber or perlite.

2.11 FLASHINGS

Bituminous flashings in accordance with these specifications shall be used throughout unless otherwise specified or indicated.

PART 3 EXECUTION

3.1 COORDINATION

The entire roofing system, excluding flood coat and aggregate surfacing, shall be finished in 1 operation up to the line of termination at end of

day's work. Phased construction will not be permitted.

3.1.1 Insulation

Application of roofing shall immediately follow application of insulation as a continuous operation. Roofing operations shall be coordinated with insulation work so that all roof insulation applied each day is waterproofed the same day. Insulation is specified in Section 07220 ROOF INSULATION.

3.1.2 Sheet Metalwork

Roofing operations shall be coordinated with sheet metalwork so that sheet metal items are installed to permit continuous roof surfacing operations the same day felts are installed. Sheet metalwork is specified in Section 07600 SHEET METALWORK, GENERAL.

3.2 ENVIRONMENTAL CONDITIONS

Air temperature shall be above 40 degrees F and there shall be no visible ice, frost, or moisture on the roof deck at the time roofing is installed.

3.3 PREPARATION REQUIREMENTS

The substrate construction of a bay or section of the building shall be completed before roofing work is begun thereon. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Nailers, curbs and other items attached to roof surface shall be in place before roofing is begun.

3.4 INSTALLATION OF CANTS

Cants shall be installed in the angles formed between the roof and walls or other vertical surfaces. Cants shall be laid in a solid coat of bituminous cement just prior to laying the roofing plies. Cants shall be continuous, and shall be installed in lengths as long as practicable. Additional cants are not required at locations where cast-in-place cants are integrally formed with the structural deck or roof fill.

3.5 CONDITION OF SURFACES

Surfaces shall be inspected and approved immediately before application of roofing and flashings. The roofing and flashings shall be applied to a smooth and firm surface free from ice, frost, visible moisture, dirt, projections, and foreign materials.

3.6 MECHANICAL APPLICATION DEVICES

Mechanical application devices shall be mounted on pneumatic-tired wheels, and shall be designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

3.7 PRIMING

Metal surfaces to receive bitumen or bituminous **AM# 0001 cement** shall be uniformly coated with primer and allowed to dry. Primer shall be compatible with the bitumen to be used.

3.8 HEATING OF BITUMEN

Asphalt shall not be heated higher than 75 degrees F above the EVT or 50 degrees below the flash point or 525 degrees F (maximum) whichever is lower. EVT and flash point temperatures of asphalt in the kettle shall be conspicuously posted on the kettle. Heating kettles shall be provided with automatic thermostatic controls and an accurate thermometer. Kettle operators shall be in attendance at all times during the heating to ensure that the maximum temperature specified is not exceeded. Equipment utilizing flame-heat shall not be placed on the roof.

3.9 BITUMEN APPLICATION

Asphalt shall be applied within a range of 25 degrees F below to 25 degrees F above the EVT. Application temperatures shall be measured at the mop bucket or mechanical applicator. Bitumen at a temperature below the recommended temperature shall be returned to the kettle. Each layer of felt shall be laid in not less than 20 pounds nor more than 35 pounds of asphalt per square **AM# 0001 .** . Where solid moppings are required, the following requirements as evidenced in any one roof cut-out sample shall apply:

a. Overlapping voids between two or more plies are not acceptable.

b. The maximum length of any individual void that is encapsulated in bitumen shall be 2 inches.

c. The total length of all voids encapsulated in bitumen shall not exceed 4 inches between any two plies.

d. Dry voids (the absence of bitumen between plies) are not acceptable.

e. Voids continuous through the specimen are not acceptable.

f. Visual interply moisture in voids is not acceptable.

3.10 APPLICATION OF FELTS

Felt plies shall be laid at right angles to the slope of the deck with minimum 6 inch end-laps staggered at least 12 inches. Felts shall be applied in 36 inch widths with 24 2/3 inch side laps and starter sheets 12, 24 and 36 inches wide along eaves to maintain 4 full plies including the base sheet when used. The full 36 inch width of each ply shall be placed in hot bitumen immediately behind the applicator. A broom or follow through tool shall be used to eliminate air pockets and obtain complete adhesion between plies. Bitumen shall be visible beyond all edges of each ply as it is being installed. Plies shall be laid free of wrinkles, creases or fishmouths. Each layer of roofing felt shall be carried up to the top of the cant. Workers shall not walk on mopped surfaces when the bitumen is fluid. For slopes exceeding 1/2 inch per foot, each felt ply, other than venting base sheet, shall be nailed 2 inches and 6 inches from upper edge with nails spaced 12 inches on centers in each row.

3.10.1 On **AM# 0001** Insulation Surfaces

Four plies of 36 inch wide glass roofing felts shall be placed shingle-fashion in solid mopped bitumen.

3.11 PROTECTION OF APPLIED ROOFING

At end of day's work or whenever precipitation is imminent, the terminated edge of built-up roofing shall be sealed with 2 full width strips of roofing felt set in and coated with bituminous cement. One half-width of the strips shall be extended up and over the finished roofing and the other half-width extended out and onto the bare roof deck. Sealing strips shall be removed before continuing installation of roofing. To facilitate sealing, termination edges may be straightened with pieces of insulation board which shall be removed when work is resumed.

3.12 FLASHINGS

Flashings shall be provided over cants in the angles formed at walls and other vertical surfaces and where required to make the work watertight. Bituminous flashings described below shall be used, except where metal flashings are specified in other sections of the specifications. Flashings shall be provided and installed immediately after the top ply of felt is placed and before the flood coat and aggregate are placed, adjacent to the flashing. **AM# 0001**

3.12.1 Base Flashings

Base flashings shall be a 2-ply system using **AM# 0001** a hot-mopped glass roofing felt inner ply, with a hot-mopped, mineral surfaced modified bitumin flashing sheet as the outer ply. The top of the base flashing shall be at least 8 inches above the roof membrane surface. Mineral surfaced flashing strips shall be cut from the width of the rolls, and shall extend from the reglet or top of curb onto the roof at least 2 inches beyond the widest flashing ply. Laps shall be shingled in a direction down slope or away from the prevailing wind. The top edge of base flashing systems shall be nailed a maximum of 8 inches on center.

3.12.2 Strip Flashings

Sheet metal flashings, **AM# 0001** installed over the roofing top ply shall be strip flashed with 2 layers of roofing felt. The first stripping ply shall lap edges of metal flashing a minimum of 4 inches. The second ply shall lap edges of the first ply a minimum of 4 inches.

3.13 WALKWAYS

Walkways shall be mineral-surfaced asphalt planks, back-mopped and embedded in the flood coat prior to aggregate surfacing and shall be located as indicated.

3.14 AGGREGATE SURFACING

After roofing felts have been laid and flashings installed, the roof surface, except for cants, shall be flood-coated uniformly with 60 pounds of hot asphalt per square. Aggregate surfacing materials shall be spread on the hot bitumen at a rate of 400 pounds per square for gravel or 300

pounds per square for other approved surfacing aggregate.

AM #0003 3.16.1 TESTING

Aggregate testing for Gradation and Decant will occur for every 10,000 square feet of roof or fraction thereof per ASTM D 1863.

3.15 ROOF CUT-OUT TESTS

Roof cut-out samples shall be taken and analyzed in accordance with ASTM D 3617 as directed by the Contracting Officer when there is reason to believe that deficiencies exist in the roofing membrane. When samples indicate deficiencies in the built-up roofing, corrective action shall be taken as directed.

3.16 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roofing with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Inspection shall include, but not be limited to, the following:

a. Environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.

b. Verification of compliance of materials before, during, and after installation.

c. Inspection of condition of equipment and accuracy of thermometers and metering devices.

d. Inspection of flashings, cants and curbs.

e. Inspection of membrane placement, **AM# 0001** widths of starter sheets, laps, proper use of broom or squeegee, and mechanical fastening.

f. Inspection of application of bitumen, aggregate, and walkways.

g. Inspection of embedment of aggregate for required weight and coverage.

h. Cutout sampling and analysis as directed.

A roofing technician responsible directly to the Contractor and experienced in the construction of built-up roofing systems and related work shall perform the inspection functions and be on the site whenever roofing operations are in progress.

3.17 INFRARED INSPECTION

Eight months after completion of the roofing system, the roof surface shall be inspected using infrared (IR) imaging as specified in ASTM C 1153. Where the IR inspection indicates wet insulation, sample cuts shall be taken (including a sample from a suspected dry area) and the moisture

content of insulation shall be determined. Insulation shall be replaced where moisture content exceeds the following values: wood fiber: 30 percent, glass fiber: 25 percent, perlite board: 25 percent, and polyurethane: 60 percent. Wet insulation, overlying roofing and sample-cut areas shall be replaced as directed.

-- End of Section --

SECTION 07600

SHEET METALWORK, GENERAL
AM# 0003

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 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 526	(1990) Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process
ASTM B 32	(1996) Solder Metal
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 543	(1995) Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D 822	(1996) Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Exposure Apparatus
ASTM D 828	(1993) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation-Apparatus
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2822	(1991; R 1997) Asphalt Roof Cement

ASTM D 3656	(1994) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM D 4022	(1994) Coal Tar Roof Cement, Asbestos Containing
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free
ASTM E 96	(1995) Water Vapor Transmission of Materials

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089	(1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-02	(1993; Errata) Architectural Sheet Metal Manual

1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction.

1.2.1 Coordination

Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Application of bituminous strip flashing over various sheet metal items is covered in Section 07510 BUILT-UP ROOFING. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in Division 15.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Materials; FIO.

Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the requirements specified below and to the thicknesses and configurations established in Table I. All materials shall be compatible with roofing manufacturer's recommendations. **AM# 0001** All materials used the standing seam metal roofing system shall be in accordance with system manufacturer's recommendations.

2.1.1 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.

2.1.2 Aluminum Extrusions

ASTM B 221, Alloy 6063, Temper T5.

2.1.3 Bituminous Cement

Type I asphalt cement conforming to ASTM D 2822 or ASTM D 4586. For coal tar roofing; coal tar cement conforming to ASTM D 4022.

2.1.4 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section 07900 JOINT SEALING.

2.1.5 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application.

2.1.6 Felt

ASTM D 226, Type I.

2.1.7 Polyvinyl Chloride (PVC) Reglets

ASTM D 1784, Class 14333D, 0.075 inch minimum thickness.

2.1.8 Galvanized Steel

AM #0003

AM #0003 Pre-finished galvanized steel shall factory primed and coated with full strength fluoropolymer (containing a minimum of 70 per cent Kynar 500 resin). Color shall be as indicated in Section 09915 COLOR SCHEDULE. Pre-finished coating shall carry a 20-year manufacturer's warranty against

cracking, peeling, blistering and color change in excess of 5 NBS units as measured in accordance with ASTM D2244, and chalking in excess of 8 as measured in accordance with ASTM D 4214. Refer to Section **AM# 0001 07412 NON STRUCTURAL STANDING METAL ROOF** for specifications on the finishes required.

2.1.9 Copper

ASTM B 370, Temper H 00.

2.1.10 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.11 Through-Wall Flashing

c. Nonreinforced, waterproof, impermeable extruded elastomeric single ply sheeting not less than 30 mils thick.

d. Three ounce copper sheet, with 2 mils of dense, clear, polyethylene sheet bonded to each side of the copper.

e. Other through-wall flashing material may be used provided the following performance criteria are met.

(1) No cracking or flaking when bent 180 degrees over a 1/32 inch mandrel and re bent at the same point over the same mandrel in an opposite direction at 32 degrees F.

(2) Water vapor permeability not more than 2 perms when tested in accordance with ASTM E 96.

(3) Minimum breaking strength of 90 pounds per inch width in the weakest direction when tested in accordance with ASTM D 828.

(4) No visible deterioration after being subjected to a 400-hour direct weathering test in accordance with ASTM D 822.

(5) No shrinkage in length or width and less than 5 percent loss of breaking strength after a 10-day immersion, per ASTM D 543, in 5 percent (by weight) solutions, respectively, of sulfuric acid, hydrochloric acid, sodium hydroxide or saturated lime (calcium hydroxide).

2.1.12 Louvers

Louvers shall be fabricated of galvanized steel or stainless steel, in accordance with the details shown in SMACNA-02. Fixed blades shall be accurately fitted and firmly secured to the frame by riveting and soldering. The edges of louver blades shall be folded or beaded for rigidity, and baffled to exclude diving rain. Louvers shall bear the AMCA Certified Ratings Seal for air performance and water penetration ratings as described in AMCA 500.

2.1.13 Louver Screen

Type I commercial bronze **AM# 0001 bird** screening conforming to ISWA IWS 089.

PART 3 EXECUTION

3.1 GENERAL

Items such as gutters, downspouts **AM# 0001, headers** and louvers shall be fabricated in conformance with SMACNA-02 and as indicated. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 1/2 inch hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips. Bituminous cement shall not be placed in contact with roofing membranes other than built-up roofing.

3.2 EXPANSION JOINTS

Expansion joints shall be provided as specified in SMACNA-02. Expansion joints in continuous sheet metal shall be provided at 40 foot intervals for copper and stainless steel except extruded aluminum gravel stops and fascias which shall have expansion joints at not more than 12 foot spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

3.3 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods:

3.3.1 Paint

Aluminum surfaces shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint as specified in Section 09900 PAINTING, GENERAL.

3.3.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and cemented to the aluminum surface using a cement compatible with aluminum.

3.4 CONNECTIONS AND JOINTING

3.4.1 Soldering

Soldering shall apply to copper, and stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pretinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing soda and rinsed with clean water.

3.4.2 Riveting

Joints in aluminum **AM# 0001 or galvanized steel** sheets 0.040 inch or less in thickness shall be mechanically made.

3.4.3 Seaming

Flat-lock and soldered-lap seams shall finish not less than 1 inch wide. Unsoldered plain-lap seams shall lap not less than 3 inches unless otherwise specified. Flat seams shall be made in the direction of the flow.

AM# 0001 JOINTING

See Table 2 for jointing requirements.

3.5 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 1/8 inch apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 12 inches on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

3.6 GUTTERS AND DOWNSPOUTS

Gutters **AM# 0001 , headers** and downspouts shall be installed as indicated. Gutters shall be supported as indicated. Downspouts shall be rigidly attached to the building. Supports for downspouts shall be spaced according to manufacturer's recommendations.

3.7 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be covered up by an application of bituminous plastic cement at the perforation. Flashing shall be installed on top of joint reinforcement. Flashing shall be formed to direct water to the outside of the system.

3.7.1 Base Flashing

Metal base flashing shall be coordinated with roofing work. Metal base flashing shall be set in plastic bituminous cement over the roofing membrane, nailed to nailing strip, and secured in place on the roof side with nails spaced not more than 3 inches on centers. Metal base flashing shall not be used on built-up roofing.

3.7.2 Counter Flashings

Except as otherwise indicated, counter flashings shall be provided over

base flashings. Counter flashing shall be installed as shown on the drawings. Where bituminous base flashings are provided, the counter flashing shall extend down as close as practicable to the top of the cant strip or lap the base flashing a minimum of 4 inches. Counter flashing shall be factory formed to provide spring action against the base flashing.

3.7.3 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.7.4 Through-Wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Flashing shall not extend further into the masonry backup wall than the first mortar joint. Joints in flashing shall be lapped and sealed. Flashing shall be one piece for lintels and sills.

3.7.4.1 Lintel Flashing

Lintel flashing shall extend the full length of lintel. Flashing shall extend through the wall one masonry course above the lintels and shall be bent down over the vertical leg of the outer steel lintel angle not less than 2 inches, or shall be applied over top of masonry and precast concrete lintels. Bed joints of lintels at control joints shall be underlaid with sheet metal bond breaker.

3.7.4.2 Sill Flashing

Sill flashing shall extend the full width of the sill and not less than 4 inches beyond ends of sill except at control joint where the flashing shall be terminated at the end of the sill.

3.7.5 Valley Flashing

Valley flashing shall be installed as specified in SMACNA-02 and as indicated.

3.8 GRAVEL STOPS AND FASCIA

Gravel stops and fascia shall be fabricated and installed as indicated and in accordance with SMACNA-02.

3.9 INSTALLATION OF LOUVERS

Louvers shall be rigidly attached to the supporting construction. The installation shall be rain-tight. Louver screen shall be installed as indicated.

3.10 REGLETS

Reglets shall be a factory fabricated product of proven design, complete with fittings and special shapes as required. Open-type reglets shall be

filled with fiberboard or other suitable separator to prevent crushing of the slot during installation. Reglet plugs shall be spaced not over 12 inches on centers and reglet grooves shall be filled with sealant. Friction or slot-type reglets shall have metal flashings inserted the full depth of slot and shall be lightly punched every 12 inches to crimp the reglet and counter flashing together. Polyvinyl chloride reglets shall be sealed with the manufacturer's recommended sealant.

3.11 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification of compliance of materials before, during, and after installation.

c. Inspection of sheet metalwork for proper size and thickness, fastening and joining, and proper installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

TABLE 1. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Item Description	Copper, oz. per sq. ft.	Aluminum, inch	Stainless steel, inch	Galvanized steel, gage
EXPOSED SHEET METAL:				
Building expansion joints:				
Cap.....	16	0.032	---	24
Waterstop - bellows or flanged-U-type.....	16	---	---	24
Cleats (Continuous)...	24	0.050	0.015	20
Covering on minor flat, pitched or curved surfaces.....	20	---	0.018	24
Downspouts, heads and leaders.....	16	0.032	---	24

Flashings:				
Base.....	20	---	---	24
Cap, stepped or valley.....	16	0.032	---	24
Gravel stops and fascias				
Extrusions	--	0.075	---	---
sheets, corrugated	16	0.032	---	24
sheets, smooth	--	0.050	---	24
Gutters (girth):				
Up to 15 inches.....	16	0.025	---	26
15 to 20 inches.....	16	0.032	---	24
20 to 25 inches.....	20	0.051	---	22
25 to 30 inches.....	24	0.064	---	20
Gutter brackets (girth):				
Up to 15 inches.....	1/8"xl"	3/16"xl"	---	1/8"x1"
15 to 20 inches.....	1/4"xl	1/4"xl	---	1/8"x1-1/2"
20 to 24 inches.....	1/4"x1-1/2"	1/4"x2"	---	1/8"x2"

TABLE 1. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES (continued)

Item Description	Copper, oz. per sq. ft.	Aluminum, inch	Stainless steel, inch	Galvanized steel, gage
Gutter cleats and cover plates.....	16	0.032	---	26
Scupper, conductor head and lining.....	16	0.032	---	25
Strainers (wire gage).....	No. 9	No. 10	---	No. 12
Reglets.....	10	---	---	---
Splash pans.....	16	0.040	---	24
Counter flashings.....	16	---	---	24
Pressure Bars.....l	1/4x3/16x2"	---	---	1/4x3/16x2"
Expansion Joint Curb Clip.....	---	---	---	1/8x8"
Counter flashing Receiver.....	20	---	---	20
Cradle Support.....	3/16xl"	---	---	3/16xl"
Sanitary Vent Pipe Flashing*.....	16	---	---	24
Tubular Penetration Flashing.....	16	---	---	24
"H" Column hood flashing.....	---	---	---	16
Roof drain gravel stop.....	16	---	---	---
Bond breaker.....	16	---	.015	---

*4 lb. lead and preformed neoprene also recommended for metal and PVC pipes, respectively.

TABLE 1. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES (continued)

Item Description	Copper, oz. per sq. ft.	Aluminum, inch	Stainless steel, inch	Galvanized steel, gage
Louvers (Width, inches):				
Up to 24 inches.....	---	.040	.025	24
24 to 36 inches.....	---	.040	.031	20
36 to 48 inches.....	---	.064	.037	18
48 to 60 inches.....	---	.064	.050	16
Copings.....	16	0.032	.015	25
Pitch pockets.....	16	---	---	24
Through-wall, flashings above roof line.....	16	---	.015	---
Through-wall, below roof line, except as otherwise specified in paragraph MATERIALS	10	---	.010	---

TABLE 2. SHEET METAL JOINTS

Type of Joint

Item Designation	Copper, Galvanized Steel, Stainless Steel	Aluminum	Remarks
Building expansion joint at roof	1-1/4 inch single lock standing seam, cleated.	1-1/4 inch single standing seam, cleated.	-----
Cleats (Continuous)	Butt	Butt	-----
Flashings:			
Base	1-inch, flat locked, soldered.	1-inch flat locked, sealed.	Use hard setting sealant for locked aluminum joints
	3-inch lap for expansion joint.	3-inch lap for expansion joint.	Each expansion joint for all metals shall have one continuous strip of 1/16-inch thick by 1/4-inch wide preformed tape sealant.
Cap-in reglet elastomeric	3-inch lap.	3-inch lap.	Seal groove with sealant (a).
Cap - two-piece	Receiver 3-inch lap. Cap piece 3-inch lap.	-----	-----
Stepped	3-inch lap.	3-inch lap.	-----
Through-wall spandrel flashing (metal)	1-1/2 inch mechanical interlock.	-----	-----

TABLE 2. SHEET METAL JOINTS (Cont)

Type of Joint

Item Designation	Copper, Galvanized Steel, Stainless Steel	Aluminum	Remarks
Through-wall spandrel flashing (Coated or non-metal)	-----	-----	3 inch lap with sealant
Valley	6-inch lap, cleated.	6-inch lap, cleated.	-----
Gravel stops: Extrusions	-----	Butt with 1/2-inch space.	Use sheet flashing beneath and a cover plate.
Sheet, corrugated	Butt with 1/4-inch space.	Butt with 1/4-inch space.	Use sheet flashing beneath and a cover plate or a combination unit.
Sheet, smooth	Butt with 1/4-inch space.	Butt with 1/4-inch space.	Use 6-inch cover plate.
Gutters	1-1/2 inch lap, riveted and soldered.	1-inch flat locked, riveted, and sealed.	Use hard setting sealant for locked aluminum joints.
Pitch pockets	1-inch soldered lap.	1-inch flat locked and sealed.	Use hard setting sealant for locked aluminum joints.

TABLE 2. SHEET METAL JOINTS (continued)

Type of Joint

Item Designation	Copper, Galvanized Steel, Stainless Steel	Aluminum	Remarks
Reglets	Butt joint.	-----	Seal reglet groove with elastomeric sealant.(a)

(a) Polyvinyl chloride type reglet shall be sealed with manufacturer's recommended butyl rubber sealant.

-- End of Section --

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SECTION 08330

OVERHEAD ROLLING DOORS
AM #0003

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 653/A 653M	(1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip process
ASTM E 84	(1997a) Surface Burning Characteristics of Building Materials
ASTM E 330	(1996) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE Fundament HDBK-IP	(1997) Handbook, Fundamentals I-P Edition
ASHRAE Fundament HDBK-SI	(1997) Handbook, Fundamentals SI Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1993; Rev 1, Rev 2, Rev 3) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 80	(1995) Fire Doors and Fire Windows

1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door.

1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of 25_____ psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load. Test data showing compliance with design windload requirements for the specific door design tested in accordance with the uniform static air pressure difference test procedures of ASTM E 330 shall be provided. Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested

1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Overhead Rolling Door Unit; FIO_____.

Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs.

SD-04 Drawings

Overhead Rolling Door Unit; FIO_____.

Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

SD-06 Instructions

Overhead Rolling Door Unit; FIO____.

Manufacturer's preprinted installation instructions.

SD-14 Samples

Overhead Rolling Door Unit; FIO____.

Manufacturer's standard color samples of factory applied finishes.

SD-19 Operation and Maintenance Manuals

Operation Manual; FIO_____.

Maintenance and Repair Manual ; FIO_____.

Six copies of the system operation manual and system maintenance and repair manual for each type of door and control system.

1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.6 OPERATION AND MAINTENANCE MANUALS

Operating instructions outlining the step-by-step procedures required for motorized door and shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

PART 2 PRODUCTS

2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted on interior side of walls.

2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on

brackets, and shall be balanced by helical torsion springs. Steel slats for doors less than 15 feet wide shall be minimum bare metal thickness of 0.0269 inches.] [[Steel] [stainless steel] slats for doors from 15 feet wide to 21 feet wide shall be minimum bare metal thickness of 0.0329 inches.

Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above.

2.1.1.1 Non-Insulated Curtains

Curtains shall be formed of interlocking slats of shapes standard with the manufacturer. Slats for exterior doors shall be flat type.

2.1.2 Endlocks and Windlocks

The ends of each alternate slat for interior doors shall have steel endlocks of manufacturer's stock design. In addition to endlocks, non-rated exterior doors shall have the manufacturer's standard windlocks as required to withstand the wind load. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind pressure.

2.1.3 Bottom Bar

The curtain shall have a off-set bottom bar consisting of two hot-dip galvanized steel angles for steel doors. A sensing edge shall be attached to the bottom bar of doors that are electric-power operated.

2.1.4 Guides

Guides shall be steel structural shapes or formed steel shapes, of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload. Doors and guides in hazardous areas shall have static grounding.

2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 0.03 inch per foot of span. Ends of the barrel shall be closed with metal plugs, machined to fit the pipe. Aluminum plugs are acceptable on non-fire door barrels.

2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be provided for spring tension adjustment from outside of the bracket without removing the hood.

2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft

housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

2.1.8 Hoods

Hoods shall be steel with minimum bare metal thickness of 0.0209 inches formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

2.1.9 Weatherstripping

Exterior doors shall be fully weatherstripped. A compressible and replaceable weather seal shall be attached to the bottom bar. Weather seal at door guides shall be continuous vinyl or neoprene, bulb or leaf type, or shall be nylon-brush type. A weather baffle shall be provided at the lintel or inside the hood. Weatherstripping shall be easily replaced without special tools.

2.1.10 Operation

Doors shall be operated by means of hand-chain . Equipment shall be designed and manufactured for usage in non-hazardous areas.

2.1.10.1 Manual Hand-Chain Operation

Operation shall be by means of a bronze (in hazardous areas) endless chain extending to within 3 feet of floor. Reduction shall be provided by use of roller chain and sprocket drive or suitable gearing, to reduce the pull required on hand chain to not over 35 pounds. Gears shall be high grade gray cast iron.

2.1.11 Inertia Brake

Overhead rolling door shall have a mechanical inertia brake device which will stop the door from free fall in any position, should there be a failure in the roller chain drive. The unit shall be capable of being reset with a back drive action.

2.1.12 Locking

Locking shall consist of chain lock keeper, suitable for padlock by others, for chain operated doors.

2.1.13 Finish

Steel slats and hoods shall be hot-dip galvanized G90 in accordance with ASTM A 653/A 653M, and shall be treated for paint adhesion and shall receive a factory baked-on prime coat for field finishing. The paint system shall withstand a minimum of 1500 hours without blistering, bubbling, or rust. Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer. Color shall be in accordance with Section 09915 COLOR SCHEDULE .

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 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be in accordance with Section 09915 COLOR SCHEDULE .

-- End of Section --

SECTION 08353

OPERABLE PARTITIONS
AM# 0003

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 E 84	(1998el) Surface Burning Characteristics of Building Materials
ASTM E 90	(1997) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E 413	(1987; R 1994) Rating Sound Insulation
ASTM F 793	(1993) Standard Classification of Wall covering by Durability Characteristics

CODE OF FEDERAL REGULATIONS (CFR)

28 CFR 36	Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities

FEDERAL STANDARDS (FED-STD)

FED-STD 795	(Basic) Uniform Federal Accessability Standards

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates

UNDERWRITERS LABORATORIES (UL)

UL 10B	(1997) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Operable Partitions; FIO.

Manufacturer's descriptive data, performance charts, catalog cuts, and installation instructions.

SD-04 Drawings

Operable Partitions; FIO.

Drawings containing complete schematic diagrams and details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-13 Certificates

Operable Partitions; FIO.

Certificate attesting that the materials meet the requirements specified and that partitions have specified acoustical and flame retardant properties, as determined by test.

SD-14 Samples

Operable Partitions; GA.

Manufacturer's standard color samples of specified surfaces and finishes.

SD-19 Operation and Maintenance Manuals

Operable Partitions; FIO.

Six complete copies of operating instructions outlining the procedures required for electrically operated partitions. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and operating features. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service.

Six complete copies of maintenance instructions explaining routine maintenance procedures including inspection, adjustments, lubrication, and cleaning. The instructions shall list possible breakdown, methods of repair, and a troubleshooting guide. The instructions shall include equipment layout and simplified wiring and control diagrams of the system as installed.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in the manufacturer's original, unopened packages and shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend

beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 MATERIALS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Door and partition finishes shall have a Class A rating when tested in accordance with ASTM E 84.

2.1.1 Wall Covering

The wall covering shall conform to manufacturer's standard as indicated in Section 09915 - COLOR SCHEDULE.

2.1.2 Hardware

Operable partitions shall have manufacturers standard hardware. Hardware shall be anodized aluminum with a bronze finish.

2.1.3 Sweep Strips

Sweep strips shall be vinyl or other material which will not crack or craze with severe usage. Sweep strip shall control STC to the specified rating.

2.1.4 Track

Track shall be recessed and shall be of extruded aluminum. Track shall be manufacturer's standard product designed for the weight of partition furnished. Track sections shall be provided in the maximum lengths practicable, not less than 6 feet long except for narrow doors and at ends of runs where short length is required. Suitable joint devices such as interlocking keys shall be provided at each joint to provide permanent alignment of track.

2.1.5 Metal Soffit

Soffit shall be provided when track is recessed. Soffit shall be of metal of adequate thickness to protect the ceiling from damage by door operation and shall be provided with the door manufacturer's standard neutral-color applied finish. Soffit on aluminum track shall be an integral part of the track.

2.2 OPERABLE PARTITIONS

AM #0003 Operable partitions are hinged pair operation with 4-foot wide panels, with an expander panel closure.
Operable partitions shall **AM #0003have** top hung ball bearing carriers and shall be full height to track. Panels shall have surface material which wraps around the vertical panel edges without vertical trim. Panels shall be constructed of precision- extruded 6063-T5 aluminum with steel reinforced corner gussets and rigid structural panels on both sides of frame. Panel thickness and composition shall be designed to provide an STC

rating of not less than 46 to 49 in accordance with ASTM E 90 and ASTM E 413. Doors shall have vinyl sweep top seals which compress against the bottom of the top track. **AM# 0001 Operable b**ottom seals shall be a vinyl sweep mechanical seal which will expand in place or panels which will be lowered by self-contained operating device. Panels shall lock in place to form a stable, rigid partition. Panels shall be surfaced with wall covering. Partition finish shall have a flame spread rating of not more than 25 in accordance with ASTM E 84. Doors shall be non fire rated manually operated.

2.3 PASS DOOR

Pass doors shall be the same thickness, construction, and finish as the operable partitions. Doors shall be provided with positive latch and flush pulls for panic operation. Doors shall be equipped with adjustable floor seals. Doors shall be nominal 3 feet wide by height standard with the manufacturer and handed as shown.

2.4 COLOR

Color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's approved installation instructions.

-- End of Section --

SECTION 08700

BUILDERS' HARDWARE
Amendment #0003

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 E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA L & R Directory	(Effective thru Jun 1999) Directory of Certified Locks & Latches
BHMA Closer Directory	(Effective thru Jul (1999) Directory of Certified Door Closers
BHMA Exit Devices Directory	(Effective thru Aug 1998) Directory of Certified Exit Devices
BHMA A156.1	(1997) Butts and Hinges
BHMA A156.3	(1994) Exit Devices
BHMA A156.4	(1992) Door Controls - Closers
BHMA A156.5	(1992) Auxiliary Locks & Associated Products
BHMA A156.6	(1994) Architectural Door Trim
BHMA A156.7	(1997) Template Hinge Dimensions
BHMA A156.8	(1994) Door Controls - Overhead Stops and Holders
BHMA A156.13	(1994) Mortise Locks & Latches
BHMA A156.15	(1995) Closer Holder Release Devices

BHMA A156.16	(1989) Auxiliary Hardware
BHMA A156.18	(1993) Materials and Finishes
BHMA A156.21	(1996) Thresholds

DOOR AND HARDWARE INSTITUTE (DHI)

DHI Keying Systems	(1989) Keying Systems and Nomenclature
DHI Locations for CSD	(1997) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames
DHI Locations for SSD	(1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames
DHI ANSI/DHI A115.1G	(1994) Installation Guide for Doors and Hardware
DHI ANSI/DHI A115-W	(Varies) Wood Door Hardware Standards (Incl All5-W1 thru A115-W9)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows
NFPA 101	(1997; Errata 97-1; TIA-97-1) Life Safety Code
NFPA 105	(1999) Installation of Smoke-Control Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Hardware and Accessories; FIO.

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, exit devices, closers, electro-magnetic closer holder release devices, , after approval of the detail drawings, and not later than 3 month(s) prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-04 Drawings

Hardware Devices; GA.

Detail drawings for hardware devices for computerized keying systems, magnetic cards, keyless push button access control systems, and other

electrical hardware devices showing complete wiring and schematic diagrams and other details required to demonstrate proper function of units.

SD-07 Schedules

Hardware Schedule; GA.

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; the ANSI number specified, sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; lock trim material thicknesses; lock trim material evaluation test results corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

Keying Schedule; GA.

Keying schedule developed in accordance with DHI Keying Systems, after the keying meeting with the user.

SD-13 Certificates

Hardware and Accessories; GA.

The hardware manufacturer's certificates of compliance stating that the supplied material or hardware item meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of the product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. A statement that the proposed hardware items appear in BHMA L & R Directory, BHMA Closer Directory and BHMA Exit Devices Directory directories of certified products may be submitted in lieu of certificates. Furnish a separate certificate of compliance attesting that hardware items conform to the Section 00700 Contract clauses pertaining to the Buy American Act.

SD-14 Samples

Locksets; GA.

1.3 PREDELIVERY CONFERENCE

Upon approval of the Hardware Schedule, the construction Contractor shall arrange a conference with the hardware supplier, Contracting Officer and the using agency to determine keying system requirements. Location of the key control storage system, set-up and key identification labeling will also be determined.

1.4 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Where double cylinder

functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

1.5 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be provided as required to adjust hardware items.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.7 OPERATION AND MAINTENANCE MANUALS

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided. The instructions for electric locks, electric strikes, electro-magnetic closer holder release devices, and electric exit devices shall include simplified diagrams as installed.

PART 2 PRODUCTS

2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware set numbers correspond to the set numbers shown on the drawings.

2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to BHMA A156.7.

2.3 HINGES

Hinges shall conform to BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

2.3.1 Hinges for Reverse Bevel Doors with Locks

Hinges for reverse bevel doors with locks shall have pins that are made nonremovable by means such as a set screw in the barrel, or safety stud, when the door is in the closed position.

2.3.2 Contractor's Option

Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges, except where prohibited for fire doors by the requirements of NFPA 80.

2.3.3 Pivot Hinges

Pivot hinges shall conform to BHMA A156.4.

2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks, and all components thereof, including cylinders and removable cores, shall be the products of a single manufacturer. Lock fronts for double-acting doors shall be rounded. Strikes for wood frames and pairs of wood doors shall be furnished with wrought boxes.

2.4.1 Mortise Lock and Latchsets

Mortise lock, latchsets, and strikes shall be series 1000 and shall conform to BHMA A156.13, operational Grade 1. Strikes for security doors shall be rectangular without curved lip. Mortise type locks and latches for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

2.4.2 Auxiliary Locks and Associated Products

Mortise dead locks and dead latches, narrow style dead locks and dead latches, rim latches, dead latches, and dead bolts shall conform to BHMA A156.5. Bolt and latch retraction shall be dead bolt style. Strike boxes shall be furnished with dead bolt and latch strikes for Grade 1.

2.4.3 Lock Cylinders (Mortise, and Rim)

Lock cylinders shall comply with BHMA A156.5. Lock cylinder shall have not less than seven pins. Cylinders shall have key removable type cores. A master keying system shall be provided. Construction interchangeable cores shall be provided. Disassembly of knob or lockset shall not be required to remove core from lockset. All locksets, lockable exit devices, and padlocks shall accept same interchangeable cores.

2.4.4 Locksets for Lead-Shielded Doors AM #0001

Locksets for lead-shielded doors shall be provided with factory-installed lead linings. Lead linings shall not be less than the thickness of the lead in the door in which the lockset is required.

2.4.5 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design. In addition to meeting the test requirement of or BHMA A156.13, lever handles,and escutcheons shall be 0.050 inch thick, if unreinforced. If reinforced, the outer shell shall be 0.035 inch thick and the combined thickness shall be 0.070 inch except that lever shanks shall be 0.060 inchthick. 2-1/8 to 2-1/4 inches.Lever handles shall be of plain design with ends returned to no more than 1/2 inch from the door face.Lever handle shall be of solid construction.

2.5 EXIT DEVICES AND EXIT DEVICE ACCESSORIES

Exit devices and exit device accessories shall conform to BHMA A156.3, Grade 1.

2.5.1 Exit Devices and Auxiliary Items

Trim shall be of wrought construction and commercial plain design with straight, beveled, or smoothly rounded sides, corners, and edges. Adjustable strikes shall be provided for rim type and vertical rod devices. Open back strikes shall be provided for pairs of doors with mortise and vertical rod devices; except open back strikes shall be used on labeled doors only where specifically provided for in the published listings. Touch bars shall be provided in lieu of conventional crossbars and arms. Escutcheons shall be provided not less than 7 by 2-1/4 inches. Escutcheons shall be cut to suit cylinders and operating trim.

2.5.2 Door Coordinator

Door coordinator with carry bar shall be Type 21 and shall be provided for each pair of doors equipped with an overlapping astragal. The coordinator may be mechanically operated and shall be capable of holding the active door of a pair open until the inactive door has preceded it in the closing cycle. When used as fire exit hardware, the coordinator and carry bar shall be listed or labeled by a nationally recognized independent testing laboratory.

2.5.3 Automatic Flush Bolts

Automatic flush bolts shall be Type 25 in accordance with BHMA A156.3, and shall be installed at the top and bottom of the inactive leaf of pairs of fire rated doors where specified in the hardware sets. Flush bolts shall be mortised in the strike edge of the door.

2.6 KEYING

Locks shall be keyed in sets or subsets as scheduled. Locks shall be furnished with the manufacturer's standard construction key system. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks:	2 change keys each lock.
Master keyed sets:	4 keys each set.
Construction keys:	6 total.
Blank keys:	150 total.

The keys shall be furnished to the Contracting Officer arranged in a container for key control system storage in sets or subsets as scheduled.

2.7 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified. The opening resistance of closing devices shall not exceed 15 1bf applied at the latch stile or exceed 5 1bfwhere low opening resistance is scheduled.

2.7.1 Surface Type Closers

Surface type closers shall be Grade 1, Series C02000 Standard Cover with

options PT-4F, PT-4G, PT-4H, (Size 1 or 2 through Size 6), and PT-4D with back check position valve. Except as otherwise specified, sizes shall conform to the manufacturer's published recommendations. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted. Closers for doors close to a wall shall be of narrow projection so as not to strike the wall at the 90-degree open position. Closers on doors accessible to the physically handicapped shall have the closing force set for a push-pull of 2.27 kg (5 pounds) applied at the knob or handle for interior doors; for exterior doors, set to the minimum required to relatch the door.

2.8 DOOR CONTROLS - OVERHEAD HOLDERS

Door controls - overhead holders shall conform to BHMA A156.8.

2.9 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA A156.6.

2.9.1 Door Protection Plates

2.9.1.1 Kick Plates

Kick plates shall be Type J102 stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inchless for pairs of doors. Height shall be 16 inches, except where the bottom rail is less than 16 inches the plate shall extend to within 1/2 inch of the panel mold or glass bead. Edges of plates shall be beveled..

2.9.1.2 Mop Plates

Mop plates shall be Type J103 stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inchless for pairs of doors. The height shall be 4 inches.Edges of plates shall be beveled..

2.9.2 Push Plates

2.9.2.1 Flat Plates

Flat plates shall be Type J301 0.50 inch thick stainless steel. Edges of plates shall be beveled..

2.9.3 Door Pulls and Push/Pull Units

2.9.3.1 Door Pulls

Door pulls shall be Category J400 stainless steel of plain modern design. Pulls for hollow metal, mineral core wood or kalamein doors shall be Type J405 thru-bolted to Type J301 flat push plates.

2.9.4 Push and Pull Bars

Push and pull bars shall be Category J500, aluminum . Edges of mounting plates shall be beveled.

2.10 AUXILIARY HARDWARE

Auxiliary hardware, consisting of door holders, door stops, , shall conform to BHMA A156.16. Lever extension flush bolts shall be Type L14081. Dust-proof strikes shall be Type L04011 for doors that are not fire rated. Dust-proof strikes shall be Type L04021 for fire rated doors. Other auxiliary hardware of the types listed below, shall conform to BHMA A156.16. Floor mounted door stop risers shall be used on all doorstops that are not of sufficient height to stop the door.

Garment Hooks:

2.11 MISCELLANEOUS

2.11.1 Automatic Door Bottoms

Automatic door bottoms shall be mortised type with aluminum housing cover, anodized clear finish. Door bottom shall have a wool, felt, rubber, vinyl, or neoprene seal and shall be actuated by the opening and closing of the door. The door bottom shall exclude light when the door is in the closed position and shall inhibit the flow of air through the unit.

2.11.2 Metal Thresholds

Thresholds shall conform to BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. Where required, thresholds shall be modified to receive projecting bolts of flush bolts exit devices. Thresholds for doors accessible to the handicapped shall be beveled with slopes not exceeding 1:2 and with heights not exceeding 1/2 inch. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.11.3 Rain Drips

Extruded aluminum, not less than 0.07 inch thick, clear anodized . Door sill rain drips shall be 1-1/2 inches to 1-3/4 inches high by 5/8 inch projection. Overhead rain drips shall be approximately 1-1/2 inches high by 2-1/2 inchesprojection and shall extend 2 inches on either side of the door opening width.

2.11.4 Aluminum Housed Type Weatherseals

Weatherseals of the type indicated shall consist of extruded aluminum retainers not less than 0.07 inch wall thickness with vinyl, neoprene, silicone rubber, polyurethane or vinyl brush inserts. Aluminum shall be clear (natural) anodized. Weatherseal material shall be of an industrial/commercial grade. Seals shall remain functional through all weather and temperature conditions. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.11.5 Gasketing

Gasketing shall be a compression type seal, silicon based, self-adhesive product for use on steel door frames with steeldoors for 20-minute 45 minute C-label 1-hour B-label 1-1/2 hour B-label. Color shall be white.

Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.11.6 Key Control Storage System

Key control storage system shall conform to BHMA A156.5, Type E8351, capacity 150, and shall be properly labeled for key identification. Set up, identification labeling and location of the key control storage shall be as directed at the Predelivery Conference.

2.11.7 Door Stops

Wall stops, floor stops and combination stop and holders shall conform to BHMA A156.16.

2.12 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed to the weather in the finished work shall be of brass, bronze, or stainless steel. Sex bolts, through bolts, or machine screws and grommet nuts, where used on reverse-bevel exterior doors equipped with half-surface or full-surface hinges, shall employ one-way screws or other approved tamperproof screws. Screws for the jamb leaf of half-mortise and full-surface hinges attached to structural steel frames shall be one-way or other approved tamperproof type.

2.13 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA A156.18. Where painting of primed surfaces is required, painting is specified in Section 09900 PAINTING, GENERAL.

2.14 HARDWARE FOR FIRE DOORS

Hardware for fire doors shall conform to the requirements of NFPA 80and NFPA 101.

PART 3 EXECUTION

3.1 APPLICATION

Hardware shall be located in accordance with DHI Locations for CSD and DHI Locations for SSD, except that deadlocks shall be mounted 48 inches above finish floor. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI ANSI/DHI A115.1G or DHI ANSI/DHI A115-W. Door control devices for exterior doors such as closers and holders, shall be attached to doors with thru bolts and nuts or sex bolts. Alternate fastening methods may be approved by the Contracting Officer when manufacturers' documentation is submitted to verify that the fastening devices and door reinforcements are adequate to resist wind induced stresses. Electric hardware items and access control devices shall be installed in accordance with manufacturer's printed installation procedures. The door hardware for lead lined doors is installed on the job at the time the doors are fitted in the frames.

Recesses for lock-sets are lined with lead butted tightly against the door lead.

3.1.1 Hardware for Fire Doors and Smoke-Control Door Assemblies

Hardware for fire doors shall be installed in accordance with the requirements of NFPA 80. Exit devices installed on fire doors shall have a visible label bearing the marking "Fire Exit Hardware". Other hardware installed on fire doors, such as locksets, closers, and hinges shall have a visible label or stamp indicating that the hardware items have been approved by an approved testing agency for installation on fire-rated doors. Hardware for smoke-control door assemblies shall be installed in accordance with NFPA 105.

3.1.2 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

3.1.3 Key Control Storage Systems

Key control storage system shall beinstalled where directed .

3.1.4 Kick Plates and Mop Plates

Kick plates shall be installed on the push side of single-acting doors and on both sides of double-acting doors. Mop plates shall be installed on the pull side of the single acting doors.

3.1.5 Auxiliary Hardware

Lever extension flush bolts shall be installed at the top and bottom of the inactive leaf of pairs of doors. The bottom bolt shall operate into a dust-proof floor strike or threshold.

3.1.6 Thresholds

Thresholds shall be secured with a minimum of three fasteners per single door width and six fasteners per double door width with a maximum spacing of 12 inches. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4 inchthread engagement into the floor or anchoring device used. Thresholds shall have ends scribed neatly to jambs.

3.1.7 Rain Drips

Door sill rain drips shall align with the bottom edge of the door. Overhead rain drips shall align with bottom edge of door frame rabbet. Drips shall be set in sealant and fastened with stainless steel screws.

3.1.8 Weatherseals

Weatherseals shall be located as indicated, snug to door face and fastened

in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

3.1.9 Gasketing

Gasketing shall be installed at the inside edge of the hinge and head and latch sides of door frame. Frames shall be toleranced for a 1/8 inch clearance between door and frame. Frames shall be treated with tape primer prior to installation.

3.2 OPERATIONAL TESTS

Prior to acceptance of any electrical hardware system, an operational test shall be performed to determine if devices are operating as intended by the specifications. Wiring shall be tested for correct voltage, current carrying capacity, and proper grounding. Stray voltages in lock wiring shall be eliminated to prevent locking devices from releasing in critical situations.

3.3 FIELD QUALITY CONTROL

Supplier shall inspect the completed installation and certify that the hardware has been furnished and installed in accordance with the manufacturers' instructions and as specified. The inspection report shall identify any malfunctioning items and recommend adjustment or replacement as appropriate.

3.4 HARDWARE SETS

HW-1 Door no. 1,3

2 pr.	Pivots, C07162, by door manufacturer x finish to match door
2 ea.	Intermediate pivots, C07382, by door manufacturer x finish to match door
1 ea.	Exit device, type 6, Function 08 (cylinder dogging) x RHR x **AM #003 630**
1 ea.	Exit device, type 6, Function 02 (cylinder dogging) x trim to match active door x **AM #003 630**
2 ea.	Closers, C02041 x finish to match door (Provide adapter as needed to allow for clearance of overhead door stop.)
2 ea.	Overhead stop, C22541 x 626
1 ea.	Threshold, J33130 as detailed x 628
1 set	Weatherstripping, at head, jambs and meeting stiles
1 set	Rain Drip @ Door Bottom x 628

HW-2 Door no. 2

2 pr.	Pivots, C07162, by door manufacturer x finish to match door
2 ea.	Intermediate pivots, C07382, by door manufacturer x finish to match door
1 ea.	Push bar by door manufacturer x factory finish to match doors.
1 ea	Pull bar by door manufacturer x factory finish to match doors

2 ea. Closers, C02041 x finish to match door (Provide adapter as needed to allow for clearance of overhead door stop.)
2 ea. Overhead stop, C22541 x 626

HW-3 Door no. 4

1 1/2 pr. Pivots, C07162, by door manufacturer x finish to match door
1 ea. Intermediate pivots, C07382, by door manufacturer x finish to match door
1 ea. Closer, C02041 x finish to match door (Provide adapter as needed to allow for clearance of overhead door stop.)
1 ea. Exit device, type 6, Function 08 x **AM #003 630**
ea. Overhead stop, C22541 x 626
1 ea. Threshold, J33130 x 626
1 set Weatherstripping, at head and jambs and stiles
1 set Rain drip @ Door Bottom x 628

HW-4 Door no. 5,5A

1 ½ pr. Hinges, A2112 x 626
1 ea. Lockset, **AM #0001** F12 x 626
1 ea. Overhead stop, C22541 x 626
1 ea. Threshold, J32183 x 626
1 set Weatherstripping, at head and jambs and stiles
1 set Rain drip @ head and door bottom x 628
1 ea. Door sweep, R3C415 X 626

HW-5 Door no. 6

4 pr. Hinges, A2112 x 626
1 ea. Lockset, **AM #0001** F12 x 626
1 set Self Latching Extension Flush Bolt set (Type 27) x 626
1 ea. Overhead stop, C22541 x 626
1 ea. Threshold, J32183 x 626
1 set Weatherstripping, at head and jambs and stiles
1 set Rain drip @ head and door bottom x 628
1 ea. Door sweep, R3C415 X 626

HW-6 Door no. 10 (Fire Rated)

1 ½ pr. Hinges, A5111 x 630
1 ea. Lockset, **AM #0001** F12 x 630 (Ensure key side of lockset faces room number A107, COMMO room, only)
1 ea. Closer, C02021 x 630
1 ea. Kickplate, J102 x 630
1 ea. Stop, L22161 x 630
1 ea. Threshold, J32130 x 628

HW-7 Door no. 11

1 ½ pr. Hinges, A2112 x 626
1 ea. Lockset, **AM #0001 F12** x 626
1 ea. Stop, L22161 x 626
1 ea. Threshold, J32130 x 628

HW-8 Door no. 12, 13

1 ½ pr. Hinges, A5111 x 630
1 ea. Push Plate, J304 x 630
1 ea. Pull Plate, J407 x 630
1 ea. Closer, C02021 x 689 **AM #0003(provide adapter as needed to allow for clearance of overhead holder)**
1 ea. Kickplate, J102 x 630
1 ea. Mop Plate, J103 x 630
AM #0003
AM #0003 1 ea. Overhead stop, C02541 x 630

HW-9 Door no. 14

1 ½ pr. Hinges, A5111 x 626
1 ea. Lockset, F07 x 626
1 ea. Closer, C02021 x 689
1 ea. Kickplate, J102 x 630
1 ea. Mop plate, J103 x 630
1 ea. Stop, L51371 x ES x 630
1 ea. Threshold, J32130 x 628

HW-10 Door no. 15

1 ½ pr. Hinges, A2112 x 626
1 ea. Lockset, F07 x 626
1 ea. Stop, L22161 x 626
1 ea. Threshold, J32130 x 628

HW-11 Door no. 16 (Fire Rated)

1 ½ pr. Hinges, A2112 x 626
1 ea. Lockset, F07 x 626
1 ea. Closer, C02021 x 689
1 ea. Kickplate, J102 x 626
1 ea. Stop, L22161 x 626
1 ea. Threshold, J32130 x 628

HW-12 Door no. 17 (Fire Rated)

3 pr. Hinges, A5111 x 630
1 ea. Exit device, Type 3, Function 08 x 630
1 ea. Exit device, Type 2, Function 01 x 630

2 ea. Closers, C02011 x 689 (Provide adapter as needed to allow for clearance of overhead door stop.)
2 ea. Kickplates, J102 x 630
2 ea. Overhead stops, C22541 x 626
1 ea. Threshold, J32130 X 628

HW-13 Door no. 18 (Fire Rated)

4 pr. Hinges, A5111 x 630
1 ea. Lockset, **AM #0001** F12 x 630
1 ea. Automatic flushbolt, Type 25 x 630
2 ea. Closers, C02021, PT-4G x 689 (Provide adapter as needed to allow for clearance of overhead door stop.)
2 ea. Kickplate, J102 x 630
1 ea. Coordinator, Type 21A x 630
2 ea. Overhead stop, C22541 x 630
1 ea. Dust proof strike, L04011 x 628
1 ea. Threshold, J32130 x 628

HW-14 Door no. 19

By manufacturer

HW-15 Door no. 20 (Smoke Barrier)

3 pr. Hinges, A5111 x 630
1 ea. Latchset, F01 x 630
2 ea. Closers, C02011, PT-4G x 689 (Provide adapter as needed to allow for clearance of overhead door stop.)
2 ea. Overhead stop, C22541 x 626
1 ea. Automatic flushbolt, Type 25 x 630
1 ea. Dustproof strike, L004011 x 628
1 ea. Coordinator, Type 21A x 630
2 ea. Electro-magnetic overhead holders, C00011 x 630 (Ref. Fire Alarm/Detection dwg. dwg. sht. FP-5.)
1 set Smoke control system (including weatherstripping, overlapping steel astragal, automatic door bottom, and threshold)

HW-16 Door no. 21

3 pr. Hinges, A2112 x 626
1 ea. Lockset, **AM #0001** F12 by door manufacturer x finish to match door
2 ea. Closer, C02021 by door manufacturer x finish to match door (Provide adapter as needed to allow for clearance of overhead door stop.)
1 ea. Automatic flushbolt, Type 25 x finish to match door
1 ea. Dust proof strike, L04011 x 628

2 ea. Overhead holder, C22511 x 626

HW-17 Door no. 22

1 ½ pr. Hinges, A2112 x 626
1 ea. Lockset, F05 x 626
1 ea. Stop, L12141 x 626

HW-18 Door no. 23, 24

1 ½ pr. Hinges, A2112 x 626
1 ea. Lockset, **AM #0001** F12 x 626
1 ea. Stop, L12141 x 626

HW-19 Door no. 25

1 ½ pr. Hinges, A2112 x 626
1 ea. Lockset, F07 x 626
1 ea. Stop, L12141 x 626

HW-20 Door no. 26

AM #0003 1 pr. Pivot, C07111 x 626 (for lead lined door)
1 ea. Intermediate pivot, 07311 x 626 (for lead lined door)
1 ea. Lockset, F12 x 626 (for lead lined door)
1 ea. Stop, L12141 x 626

HW-21 Door no. 27

1 ea. Hinges, A2112 x 626
1 ea. Latchset, F01 x 626
1 ea. Closer, C02011 x 689
1 ea. Kickplate, J102 x 630
1 ea. Stop, L12141 x 626

HW-22 Door no. 30, 31, 33

BY MANUFACTURER

Am #0003 HW-23 Door no. 29

3 pr. Hinges, A2112 x 626
1 ea. Lockset, F07 x 626
2 ea. Stops, L12141 x 626
1 ea. Self latching extension flush bolt Type 27 x 626
1 ea. Dustproof strike, L04011 x 628
2 ea. Overhead holders, C22511 x 626

-- End of Section --

SECTION 09250

GYPSUM WALLBOARD
AM# 0003

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	(1992) Interior Installation of Cementitious Backup Units
ANSI A118.9	(1992) Test Methods and Specifications for Cementitious Backer Units

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM A 853	(1993) Steel Wire, Carbon, for General Use
ASTM B 164	(1998) Nickel-Copper Alloy Rod, Bar, and Wire
ASTM C 36	(1997) Gypsum Wallboard
ASTM C 79/C 79M	(1997) Treated Core and Non treated Core Gypsum Sheathing Board
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1996) Nails for the Application of Gypsum Board
ASTM C 557	(1993a) Adhesive for Fastening Gypsum Wallboard to Wood Framing
ASTM C 630/C 630M	(1996a) Water-Resistant Gypsum Backing Board
ASTM C 645	(1998) Nonstructural Steel Framing Members
ASTM C 754	(1997) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 840	(1998) Application and Finishing of Gypsum Board

ASTM C 931/C 931M	(1995a) Exterior Gypsum Soffit Board
ASTM C 955	(1998) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM C 960/C 960M	(1997) Predecorated Gypsum Board
ASTM C 1002	(1998) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases
ASTM C 1047	(1998) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1177/C 1177M	(1996) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1178/C 1178M	(1996) Glass Mat Water-Resistant Gypsum Backing Panel

GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board Finish
GA 216	(1996) Application and Finishing of Gypsum Board
GA 600	(1997) Fire Resistance Design Manual

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1998) Fire Resistance Directory (2 Vol.)

1.2 SYSTEM DESCRIPTION

1.2.1 Fire-Rated Construction

Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements, and as required to meet pressurization requirements. Penetrations through rated partitions and ceilings shall be sealed tight in accordance with tested systems. Fire ratings shall be as indicated.

1.2.2 Pressurized Enclosures

Pressurized fire-rated gypsum board enclosures shall allow the mechanical and electrical life-safety systems to operate in accordance with the design intent. Air pressure within elevator shaft shall be 7.5 psf. Air pressure within stair shaft shall be 5.0 psf. Maximum mid-span deflection shall be L/360.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Steel Framing; FIO. Control Joints; FIO. Fire-Resistant Assemblies; FIO.

Drawings and installation details for ceiling framing, furring, special wall framing, and framed openings in walls and ceilings.

SD-13 Certificates

Gypsum Wallboard; FIO. **AM# 0001 Tile Backer** Board; FIO. Exterior Gypsum Soffit Board; FIO. Steel Framing; FIO. Fire-Rated Gypsum Board; FIO; **AM# 0001 Exterior Cement Board**; FIO.

Certificates stating that the steel framing and gypsum wallboard meet the specified requirements.

AM# 0001
SD-14 Samples

Texture Coating; **__GA___**.

AM# 0001 Three samples indicating range of "Knock-Down" texture on 8-inches by 12-inches gysum board. Submittal sample must be approved prior to proceeding with the work.

1.4 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

1.5 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in original containers bearing the name of manufacturer, contents, and brand name. Materials shall be stored off the ground in a weathertight structure for protection. Gypsum boards shall be stacked flat, off floor and supported to prevent sagging and warpage. Adhesives and joint materials shall be stored in accordance with manufacturer's printed instructions. Damaged or deteriorated materials shall be removed from jobsite.

1.6 ENVIRONMENTAL CONDITIONS

Environmental conditions for application and finishing of gypsum board shall be in accordance with ASTM C 840. During the application of gypsum board without adhesive, a room temperature of not less than 40 degrees F shall be maintained. During the application of gypsum board with adhesive, a room temperature of not less than 50 degrees F shall be maintained for 48

hours prior to application and continuously afterwards until completely dry. Building spaces shall be ventilated to remove water not required for drying joint treatment materials. Drafts shall be avoided during dry hot weather to prevent materials from drying too rapidly.

PART 2 MATERIALS

2.1 NON-LOADBEARING STUD WALLS

2.1.1 Studs

Studs for non-load bearing walls shall conform to ASTM C 645. Studs shall be C-shaped, roll formed steel with minimum uncoated design thickness of **AM #0003 0.0329** INCHES (20 GAUGE) **AM# 0001at 16-inches O.C.** made from G40 hot-dip galvanized coated sheet.

2.1.2 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be prefabricated, U-shaped with minimum 1 inch flanges, unpunched web, thickness to match studs, made from G40 hot-dip galvanized coated sheet.

2.2 SUSPENDED CEILING FRAMING

Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of L/240. Carrying channels shall be formed from minimum 0.0548 in thick cold-rolled steel, 1-1/2 x 3/4 inch. Furring members shall be formed from cold-rolled steel, 7/8 x 2-9/16 inch. Carrying channels and furring members shall be made from hot-dip galvanized coated sheet.

2.3 GYPSUM BOARD

Gypsum board shall have square-cut ends, tapered or beveled edges and shall be maximum possible length. Gypsum board thickness shall be as shown.

2.3.1 Standard Gypsum Board

Regular gypsum board shall conform to ASTM C 36, and shall be 48 inches wide.

2.3.2 Fire-Rated Gypsum Board

Fire-rated gypsum board shall conform to ASTM C 36, and shall be Type X or Type C as required, 48 inches wide.

2.3.3 **AM# 0001 Tile Backer** Board

Tile backer board shall be 5/8" thick, regular, with water resistant core, fiberglass surface mats front and back with water and vapor retardant coating, paintable surfaces and shall be 48 inch width and maximum permissible length.

2.3.4 Exterior Cement Board

FExterior cement board shall be a non-combustible portland cement product.

Board shall be 4' x 8' with minimum thickness of 5/8". Boards shall consist of an aggregated portland cement core, faced on both sides and wrapped on long edges with an embedded polymer-coated glass fiber mesh. Bonding surface shall have a rough texture. Exterior cement shall comply with the following requirements:

PROPERTY	TEST METHOD	REQUIREMENT
Flexural Strength	ASTM C 947	750 psi, min.
Compressive Strength	ASTM D 2394	1250 psi, min.
Crack Resistance	ASTM E 72	No Cracking
Non-combustibility	ASTM E 136	Pass
Flame Spread/Smoke	ASTM E 84	5/0 max.
Water Absorption	ASTM C 948	15%
Fastener Pull Resistance	ASTM C 473	120 lb. (wet or dry)

2.3.5 Exterior Gypsum Soffit Board

Exterior gypsum soffit board shall conform to ASTM C 931/C 931M, Type X, 48 inches wide.

2.3.6 Exterior Sheathing Board

Exterior sheathing board shall conform to ASTM C 79/C 79M, Type X, shall have water-resistant core, water-repellant paper faces each side, with tongue-and-groove edges, and be 24 inches wide, or square edges and 48 inches wide, with a minimum thickness of 5/8 inches..

2.4 TRIM, MOLDINGS, AND ACCESSORIES

2.4.1 Taping and Embedding Compound

Taping and embedding compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use in embedding tape at gypsum wallboard joints and fastener heads, and shall be compatible with tape and substrate.

2.4.2 Finishing or Topping Compound

Finishing or topping compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use as a finishing compound for gypsum board.

2.4.3 All-Purpose Compound

All-purpose compound shall be specifically formulated and manufactured to use as a taping and finishing compound, and shall be compatible with tape and substrate.

2.4.4 Joint Tape

Joint tape shall conform to ASTM C 475 and shall be as recommended by gypsum board manufacturer.

2.4.5 Trim, Control Joints, Beads, Stops and Nosings

Items used to protect edges, corners, and to provide architectural features shall be in accordance with ASTM C 1047.

2.5 FASTENINGS AND ADHESIVES

2.5.1 Nails

Nails shall conform to ASTM C 514. Nails shall be hard-drawn low or medium-low carbon steel, suitable for intended use.

2.5.2 Screws

Screws shall conform to ASTM C 1002. Screws shall be self-drilling and self-tapping steel, Type S for wood or light-gauge steel framing.

2.5.3 Hangers

Suspended ceiling runner channel hangers shall be soft, annealed steel wire not less than No. 8 SWG, conforming to ASTM A 853.

2.5.4 Wire and Clip Type Fastenings

Tie wire, clips, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A 580/A 580M, composition 302, 304, or 316, Condition A.

2.5.4.1 Tie Wire

Tie wire for constructing partitions and vertical furring, for securing metal lath to supports, and for lacing shall be not less than No. 18 SWG. Tie wire for other applications shall be not less than No. 16 AWG.

2.5.4.2 Clips

Clips used in lieu of tie wire for securing the furring channels to the runner channels in ceiling construction shall be made from strip not less than 1/8 inch thick or shall be hairpin clip, formed of wire not less than 0.01620 inch nominal diameter. Other clips and rings or fastenings of similar materials shall be equivalent in holding power to that provided by tie wire for the specific application.

PART 3 EXECUTION

3.1 INTERIOR WALL FRAMING

Steel framing and furring members shall be installed in accordance with ASTM C 754. Members shall be in alignment with spacings not to exceed the maximum spacings indicated on drawings. Runners shall be aligned accurately at the floor and ceiling and securely anchored.

3.1.1 Wall Openings

The framing system shall provide for the installation and anchorage of the required subframes or finish frames for wall openings at doors, pass-through openings, and access panels. Partitions abutting continuous suspended ceilings shall be strengthened for rigidity at rough openings of more than 30 inches wide. Studs at openings shall be 0.0329 in minimum bare metal thickness and spot grouted at jamb anchor inserts. Double studs shall be fastened together with screws and secured to floor and overhead runners. Two studs, fastened back to back, shall be used for framing s doors.

3.1.2 Wall Control Joints

Control joints for expansion and contraction in the walls shall be constructed with double studs installed 1/2 inch apart in interior walls or wall furring where indicated on drawings. Control joint spacing shall not exceed 30 feet. Ceiling-height door frames may be used as vertical control joints. Door frames of less than ceiling height may be used as control joints only if standard control joints extend to ceiling from both corners of top of door frame. Control joints between studs shall be filled with insulation in fire rated partitions.

3.1.3 Blocking

Blocking shall be provided as necessary for mounted equipment. Blocking shall be **AM# 0001** wood and shall be cut to fit between framing members. Blocking shall be rigidly anchored to the framing members. Under no circumstances will accessories or other wall mounted equipment be anchored directly to gypsum wallboard.

3.2 SUSPENDED CEILING FRAMING

Suspended ceiling system framing shall be installed in accordance with ASTM C 754.

3.2.1 Hangers

Hangers shall be spaced not more than 48 inches along runner channels and 36 inches in the other direction or 42 inches in both directions unless otherwise indicated. Locations of hanger wires shall be coordinated with other work. Hangers at ends of runner channels shall be located not more than 6 inches from wall. Hanger wire shall be looped around bottom chord of open-web steel joists, or secured to structural elements with suitable fasteners. Sags or twists which develop in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced.

3.2.2 Main Runners

Main runner channels shall be installed in accordance with ASTM C 754. Hanger wires shall be double strand saddle-tied to runner channels and the ends of hanger wire shall be twisted three times around itself. Main runners shall be located to within 6 inches of the paralleling wall to support the ends of cross furring. Main runners shall not come in contact with abutting masonry or concrete walls. Where main runners are spliced, ends shall be overlapped 12 inches with flanges of channels interlocked, and shall be securely tied at each end of splice with wire looped twice around the channels.

3.2.3 Furring Channels

Furring channels shall be spaced in accordance with ASTM C 754. Furring channels shall be secured to the runner channels and to structural supports at each crossing with tie wire, hairpin clips, or equivalent fastenings. Furring channels shall be located within 2 inches of parallel walls and beams, and shall be cut 1/2 inch short of abutting walls.

3.2.4 Ceiling Openings

Support members shall be provided as required at ceiling openings for access panels, recessed light fixtures, and air supply or exhaust. Support members shall be not less than 1-1/2 inch main runner channels and vertically installed suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and wallboard attachment. Intermediate structural members not a part of the structural system, shall be provided for attachment or suspension of support members.

3.2.5 Light Fixtures and Air Diffusers

Light fixtures and air diffusers shall be supported directly from suspended ceiling runners. Wires shall be provided at appropriate locations to carry the weight of recessed or surface mounted light fixtures and air diffusers.

3.2.6 Control Joints

Ceiling control joints for expansion and contraction shall be located where indicated on drawings. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.

3.2.6.1 Interior Ceilings With Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 50 feet in either direction nor more than 2500 square feet.

3.2.6.2 Interior Ceilings Without Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 30 feet in either direction nor more than 900 square feet.

3.3 APPLICATION OF GYPSUM BOARD

Gypsum board shall be installed in accordance with ASTM C 840, GA 214 **AM# 0001** as specified. Paragraph 17.3.1 GENERAL of ASTM C 840 which permits usage of water resistant gypsum board as a base for adhesive application of ceramic or plastic tile on ceilings, does not apply. Edges and ends of gypsum boards shall be cut to obtain neat fitting joints. End joints of adjoining boards shall be staggered, and shall be staggered on opposite sides of wall. Boards shall be applied with moderate contact without forcing in place. Holes for pipes, fixtures or other small openings shall be cut with a tool which will provide a neat fit. Screws shall be driven so that the heads are slightly below the plane of paper face. Fracturing the paper face or damaging the core shall be avoided. Trim shall be installed at external and internal angles formed by the intersecting gypsum board surfaces with other surfaces. Corner beads shall be installed to

vertical and horizontal corners in accordance with manufacturer's published instructions. Boards of maximum practical length shall be used so that an absolute minimum number of end joints occur. Gypsum board partitions in rooms with ceiling heights less than 10'-0" shall have full height boards installed vertically, with no end joints in the gypsum installation.

3.3.1 Two-Ply Gypsum Board

Second layer of gypsum board shall be applied perpendicular to first layer with joints staggered and secured with mechanical fasteners. **AM# 0001**

3.3.2 Tile Backer Board

Tile backer board shall be installed per manufacturer's instructions for walls and ceilings.

3.3.3 Exterior Cement Board

Exterior cement board shall be attached on metal studs with self-tapping, wafer head, corrosion resistant screws. Screws and nails for application of the board shall be spaced not more than 8" on center on each supporting member. Edges and ends of boards shall be butted snugly, with vertical joints staggered, and joints treated with exterior tape, as recommended by system manufacturer..

3.3.4 Exterior Gypsum Sheathing

Exterior gypsum sheathing and glass mat gypsum sheathing shall be flashed at openings so that water intrusion will not contact the sheathing. Vertical end and edge joints shall abut over the centers of framing members and shall be offset a minimum of one framing space between adjacent rows of gypsum sheathing. Sheathing shall be installed in accordance with manufacturer's instructions.

3.4 TRIM, MOLDINGS, AND ACCESSORIES INSTALLATION

Trim, moldings and accessories shall be installed in accordance with GA 216.

3.5 **AM# 0001 GYPSUM BOARD FINISH**

Gypsum board shall be finished in accordance with ASTM C 840, GA-216, and GA214.
Plenum areas above ceilings shall be finished to Level 1 in accordance with GA-214.
Backing board to receive Ceramic Tile shall be finished to Level @ in accordance with GA-214.
Walls and ceilings to receive a Heavy-grade wallcovering or heavy textured finish before painting shallbe finished to Level 3 in accordance with GA-214.
Walls and ceilings without critical lighting to receive flat paints, light textures, or wallcoverings shall be finished to Level 4 in accordance with GA-214.
Unless otherwise specified, all gypsum board walls, partitions, and ceilings shall be finished to Level 5 in accordance with GA-214.

AM# 0001 3.6.2 TEXTURE

Provide texture coating on all surfaces required to be painted. Texture coating mixture shall be per manufacturers instructions to achive a "Knock Down" finished texture.

3.6 TILE BACKER

Boards used in ceilings shall be taped and finished in accordance with manufacturer's written instructions

3.7 FIRE-RESISTANT ASSEMBLIES

Gypsum wallboard construction for fire-rated assemblies shall be in accordance with UL Fire Resist Dir, or GA 600 for the design number indicated on drawings.

3.8 PATCHING

Surface defects and damage shall be corrected as required to leave gypsum board smooth, uniform in appearance, and ready to receive finish as specified.

-- End of Section --

SECTION 09310

CERAMIC TILE
07/98
AMENDMENT #0003

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1A	(1992) Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar
ANSI A108.1B	(1992) Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar
ANSI A108.4	(1992) Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive
ANSI A108.5	(1992) Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
ANSI A108.6	(1992) Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy
ANSI A108.7	(1992) Electrically Conductive Ceramic Tile Installed with Conductive Dry-Set Portland Cement Mortar
ANSI A108.8	(1992) Installation of Ceramic Tile with Chemical Resistant Furan Mortar and Grout
ANSI A108.10	(1992) Installation of Grout in Tilework
ANSI A118.1	(1992) Dry-Set Portland Cement Mortar
ANSI A118.2	(1992) Conductive Dry-Set Portland Cement Mortar
ANSI A118.3	(1992) Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive

ANSI A118.4	(1992) Latex-Portland Cement Mortar
ANSI A118.5	(1992) Chemical Resistant Furan Mortars and Grouts for Tile
ANSI A118.6	(1992) Ceramic Tile Grouts
ANSI A118.9	(1992) Cementitious Backer Units
ANSI A136.1	(1992) Organic Adhesives for Installation of Ceramic Tile
ANSI A137.1	(1988) Ceramic Tile

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM C 33	(1997) Concrete Aggregates
ASTM C 144	(1997) Aggregate for Masonry Mortar
ASTM C 150	(1997) Portland Cement
ASTM C 206	(1984; R 1997) Finishing Hydrated Lime
ASTM C 207	(1991; R 1997) Hydrated Lime for Masonry Purposes
ASTM C 241	(1990) Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 373	(1988; R 1994) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 648	(1998) Breaking Strength of Ceramic Tile
ASTM C 847	(1995) Metal Lath
ASTM C 1026	(1987; R 1996) Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1984; R 1990) Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(1996) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM C 1178/C 1178M	(1996) Glass Mat Water-Resistant Gypsum Backing Panel

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual (1991) Design Manual IV Dimensional Stone

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 99 (1999) Health Care Facilities

TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk (1997) Handbook for Ceramic Tile Installation

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Tile; FIO. Mortar, Grout, and Adhesive; FIO.

Manufacturer's catalog data.

SD-06 Instructions

Tile; FIO. Mortar and Grout; FIO.

Manufacturers preprinted installation and cleaning instructions.

SD-09 Reports

Testing; FIO.

Copy of results for electrical resistance tests.

SD-13 Certificates

Tile; FIO. Mortar, Grout, and Adhesive; FIO.

Certificates indicating conformance with specified requirements. A master grade certificate shall be furnished for tile.

SD-14 Samples

Tile; GA. Accessories; GA. Marble Thresholds; .

Samples of sufficient size to show color range, pattern, type and joints. SAMPLES TO BE SUBMITTED FOR APPROVAL TO:

ARCHITECTURAL SECTION
DESIGN BRANCH
FORT WORTH DISTRICT

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover in accordance with manufacturer's instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient temperature is at least 50 degrees F and rising. Temperature shall be maintained above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tilework.

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 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 90 lbs and 250 lbs for floor tile in accordance with ASTM C 648. Tile for cold climate projects shall be rated frost resistant by the manufacturer as determined by ASTM C 1026. Water absorption shall be 0.50 maximum percent in accordance with ASTM C 373. Floor tile shall have a minimum coefficient of friction of [0.60 wet and dry in accordance with ASTM C 1028. Floor tile shall be Class IV-Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027for abrasion resistance as related to foot traffic. Porcelain floor tile F501(Dal-tile; Rocky Mountain, Nero 806) shall be installed in a brick work square pattern. Porcelain floor tile F502 (Dal-tile; Rocky Mountain, Bianco 801) shall be installed at a 45 degree angle. Floor tile shall comply with A.D.A. recommendations for accessible routes.

2.1.1 Mosaic Tile

Ceramic mosaic tile and trim shall be unglazed porcelain unpolished with sharply formed face. Tile size shall be 2 x 2 inches . Color shall be in accordance with Section 09915 COLOR SCHEDULE.

AM#3

2.2 SETTING-BED: FIRST FLOOR ONLY

The setting-bed shall be composed of the following:

2.2.1 Aggregate for Concrete Fill

Aggregate shall conform to ASTM C 33. Maximum size of coarse aggregate shall not be greater than one-half the thickness of concrete fill.

2.2.2 Portland Cement

Cement shall conform to ASTM C 150, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Sand shall conform to ASTM C 144.

2.2.4 Hydrated Lime

Hydrated lime shall conform to ASTM C 206, Type S or ASTM C 207, Type S.

2.2.5 Metal Lath

Metal lath shall be flat expanded type conforming to ASTM C 847, and weighing not less than 2.5 pounds per square yard.

2.2.6 Reinforcing Wire Fabric

Wire fabric shall conform to ASTM A 185. Wire shall be either 2 x 2 inch mesh, 16/16 wire or 1-1/2 x 2 inch mesh, 16/13 wire.

2.3 WATER

Water shall be potable.

2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

2.4.1 Dry-Set Portland Cement Mortar

ANSI A118.1.

2.4.2 Conductive Dry-Set Mortar

ANSI A118.2.

2.4.3 Latex-Portland Cement Mortar

ANSI A118.4.

2.4.4 Ceramic Tile Grout

ANSI A118.6; latex-modified portland cement grout.

2.4.5 Cementitious Backer Board

Cementitious backer units, for use as title substrate over wood sub-floors, shall be in accordance with ANSI A118.9. Cementitious backer units shall be 5/8inch thick. Backer board shall have gypsum core with fiberglass mat surfaces (2 sides) with water and vapor retardant on face side.

2.5 MARBLE THRESHOLDS

Marble thresholds shall be of size required by drawings or conditions. Marble shall be Group A as classified by MIA Design Manual. Marble shall

have a fine sand-rubbed finish and shall be gray in color as approved by the Contracting Officer. Marble abrasion shall be not less than 12.0 when tested in accordance with ASTM C 241.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1A or ANSI A108.1B for surface conditions for the type setting bed specified and for workmanship. Variations of surface to be tiled shall fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex portland cement mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA Hdbk, method W244-99.

3.3.1 Dry-Set Mortar and Latex-Portland Cement Mortar

Dry-set or Latex-portland cement shall be used to install tile in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

3.4 INSTALLATION OF FLOOR TILE

AM#3

Floor tile shall be installed in accordance with TCA Hdbk, method **F121-99 FOR 1ST FLOOR AND METHOD**F122-99 **2ND & 3RD FLOORS.**. Thin-Bed set membran, crack protection, shall be Dal-tile CIS or equal.

3.4.1 Dry-Set and Latex-Portland Cement

Dry-set or Latex-portland cement mortar shall be used to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

3.4.2 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.10.

AM#3

3.4.3 Waterproofing

Shower pans are specified in Section 15400 PLUMBING, GENERAL PURPOSE. Waterproofing under concrete fill shall conform to the requirements of Section 07132 BITUMINOUS WATERPROOFING.

AM#3

3.4.4 Concrete Fill

Concrete fill shall be composed by volume of 1 part portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mixed with water to as dry a consistency as practicable. The fill shall be spread, tamped, and screeded to a true plane, and pitched to drains or leveled as shown. Concrete fill shall be thoroughly damp cured before application of setting-bed material . Concrete fill shall be reinforced with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped not less than 2 inches. Laps shall be tied together with 18 gauge wire every 10 inches along the finished edges and every 6 inches along the cut ends and edges. The reinforcement shall be supported and secured in the centers of concrete fills. The mesh shall be continuous; except where expansion joints occur, mesh shall be cut and discontinued across such joints. Reinforced concrete fill shall be provided under the setting-bed where the distance between the under-floor surface and the finished tile floor surface is 2 inches or greater, and shall be of such thickness that the mortar setting-bed over the concrete fill shall be not less nor more than the thickness required in the specified TCA Hdbk methods.

3.5 INSTALLATION OF MARBLE THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 1/4 inch in width and shall be grouted full as specified for ceramic tile.

3.6 TESTING

Electrical resistance tests shall be performed on conductive flooring in the presence of the Contracting Officer by a technician experienced in such work and a copy of the test results shall be furnished. Test procedures, testing apparatus, and test results shall be in accordance with the provisions for Conductive Flooring in NFPA 99.

3.7 EXPANSION JOINTS

Joints shall be formed as indicated and sealed as specified in Section 07900 JOINT SEALING.

3.7.1 Walls

Expansion joints shall be provided at control joints in backing material. Wherever backing material changes, an expansion joint shall be installed to separate the different materials.

AM#3

3.7.2 Floors

Expansion joints shall be provided over construction joints, control joints, and expansion joints in concrete slabs. Expansion joints shall be provided where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Expansion joints shall extend through setting-beds and fill.

3.8 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

-- End of Section --

SECTION 09840

ACOUSTICAL WALL TREATMENT
01/98
AMENDMENT #0003

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 ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC TM 16	(1993) Test Method: Colorfastness to Light

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 423	(1990a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM D 1117	(1997) Nonwoven Fabrics
ASTM D 5034	(1995) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM E 84	(1998el) Surface Burning Characteristics of Building Materials

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO Bldg Code	(1997) Uniform Building Code (3 Vol)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Acoustical Wall Panels; FIO.

Manufacturer's descriptive data and catalog cuts.

SD-04 Drawings

Acoustical Wall Panels; FIO.

Drawings showing plan locations, elevations and details. Drawings shall include details of method of anchorage, location of doors and other

openings, base detail and shape and thickness of materials.

SD-06 Instructions

Acoustical Wall Panels; FIO.

Manufacturer's installation instructions and recommended cleaning instructions.

SD-13 Certificates

Acoustical Wall Panels; FIO.

Certificates of compliance from an independent laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards. A label or listing from the testing laboratory will be acceptable evidence of compliance.

SD-14 Samples

Acoustical Wall Panels; GA.

Manufacturer's standard fabric swatches, minimum 18 inches wide by 24 inches long 2 samples of each color range specified.
SAMPLES TO BE SUBMITTED FOR APROVAL TO:

ARCHITECTURAL SECTION
DESIGN BRANCH
FORT WORTH DISTRICT

1.3 DELIVERY AND STORAGE

Materials delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt, dust, or other contaminants.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 FABRIC COVERED ACOUSTICAL WALL PANELS

Acoustical wall panels shall consist of prefinished factory assembled, seamless fabric covered, fiber glass or mineral fiber core system as described below. Wall panels shall be manufactured to the dimensions and configurations shown on the drawings. Perimeter edges shall be [non-reinforced.] [reinforced by either an aluminum frame or a formulated resin edge hardener.] Acoustical wall panels installed in non-sprinklered areas must comply with the requirements of ICBO Bldg Code, Standard 42-2.

a. Panel Width: Panel width shall be as detailed. See Arch. Drwgs. I-06 and I-07 for panel details. Wall shall be field measured for panel application. If adjustments are required, contractor shall provide drawings for approval to:

Architectural Section
Design Branch
Fort Worth District

b. Panel Height: Panel height shall be as detailed. See Arch. Drwgs, I-06 and I-07 for panel details. Wall shall be field measured for panel application. If adjustments are required, contractor shall provide drawings for approval to:
Architectural Section
Design Branch
Fort Worth District

c. Thickness: one inch.

d. Fabric Covering: Seamless plain woven 2-ply 100 percent polyester, minimum 8.3+/-0.5 ounces per linear yard. Tear strength shall be minimum 15 pounds. Tensile strength shall be 150 pounds minimum in accordance with ASTM D 5034. Fabric covering shall be stretched free of wrinkles and then bonded to the edges and back or bonded directly to the panel face, edges, and back of panel a minimum distance standard with the manufacturer. Light fastness (fadeometer) shall be approximately 40 hours in accordance with AATCC TM 16.

e. Fire rating for the complete composite system: Class A, 200 or less smoke density and flame spread less than 25, when tested in accordance with ASTM E 84.

f. Substrate: Fiber glass .

g. Noise Reduction Coefficient (NRC) Range: 0.80-0.90 ASTM C 423.

h. Edge Detail: Square edge.

i. Core Type: Standard acoustical core.

J. Mounting: Acoustical panels shall be mounted by manufacturer's standardmechanical fasteners

k. Color: Color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

Walls shall be clean, smooth, oil free and prepared in accordance with panel manufacturer's instructions. Installation shall not begin until all wet work, such as, plastering, painting, and concrete are completely dry.

3.2 INSTALLATION

Panel installation shall be by personnel familiar with and normally engaged in installation of acoustical wall panels. Panels shall be applied in accordance with the manufacturer's installation instructions.

3.3 CLEANING

Following installation, dirty or stained panel surfaces shall be cleaned in accordance with manufacturer's instructions and left free from defects. Panels that are damaged, discolored, or improperly installed shall be removed and new panels provided as directed.

-- End of Section --

SECTION 09915

COLOR SCHEDULE
06/93
AMENDMENT #0003

PART 1 GENERAL

1.1 GENERAL

This section covers only the color of the exterior and interior materials and products that are exposed to view in the finished construction. The word "color" as used herein includes surface color and pattern. Requirements for quality and method of installation are covered in other appropriate sections of the specifications. Specific locations where the various materials are required are shown on the drawings. Items not designated for color in this section may be specified in other sections. When color is not designated for items, the Contractor shall propose a color for approval.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-14 Samples

Color board; GA.

Three sets of color boards, 120 days after the Contractor is given Notice to proceed, complying with the following requirements:

a. Color boards shall reflect all actual finish textures, patterns, and colors required for this contract.
b. Materials shall be labeled with the finish type, manufacturer's name, pattern, and color reference.

c. Samples shall be on size A4 or 8-1/2 by 11 inch boards with a maximum spread of size A1 or 25-1/2 by 33 inches for foldouts.

d. Samples for this color board are required in addition to samples requested in other specification sections.

e. Color boards shall be submitted to:
ARCHITECTURAL SECTION
DESIGN BRANCH
FORT WORTH DISTRICT

PART 2 PRODUCTS

2.1 REFERENCE TO MANUFACTURER'S COLOR

Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal colors from other manufacturers.

2.2 COLOR SCHEDULE

The color schedule lists the colors, patterns and textures required for exterior and interior finishes, including both factory applied and field applied colors.

2.2.1 Exterior Walls

Exterior wall colors shall apply to exterior wall surfaces including recesses at entrances and projecting vestibules. Conduit shall be painted to closely match the adjacent surface color. Wall color shall be provided to match the colors listed below.

a. Brick:
ACME: Elgin, Painted Desert

AM#1
b. Mortar: **SGS P631, WHITE CEMENT/TAN SAND**

c. Pre-Engineered Building in Mechanical Yard:
AM#1 SHERWIN WILLIAMS; RED BARN SW2307

d. Metal **AM#1** Guardgate and Screening:**SHERWIN WILLIAMS; RED BARN SW2307**
Sherwin Williams; White Heron, SW2425

AM#1
e. Cast Stone: Continential, 1104 Buff

2.2.2 Exterior Trim

Exterior trim shall be provided to match the colors listed below.

a. Doors and Door Frames:
AM#1 Graham **Arch.** Products; Antique Bronze

b. Windows (mullion, muntin, sash, trim, and sill):
AM#1 Graham **Arch.** Products; Antique Bronze

d. Fascia:
USG; Fog

e. Downspouts, Gutter, Louvers, and Flashings:
AM#1 Downspouts off Standing Seam Metal Roof shall match roof,

American Buildings Company, **Terra Cotta**

Remaining Downspouts, gutter, lovers, and flashings; Sherwin Williams, White Heron, SW2425.

f. Handrails, Guardrails, Stairs:
Sherwin Williams; White Heron, SW2425

g. Soffits and Ceilings:
USG; Fog

h. Signage:
Base Standard, See Arch. Drwgs.

i. Overhangs:
USG; Fog

j. Caulking and Sealants:
Shall match surrounding material.

2.2.3 Exterior Roof

Roof color shall apply to exterior roof surfaces including sheet metal flashings and copings, mechanical units, roof trim, pipes, conduits, electrical appurtenances, and similar items. Roof color shall be provided to match the colors listed below.

a. Metal:
AM#1 American Buildings Company; **Terra Cotta**

2.2.4 Interior Floor Finishes

Flooring materials shall be provided to match the colors listed below.

b. Carpet Tile:
F101; Interface; Furrows, 1446 Top Soil

c. Vinyl Composition Tile:
F201; Mannington; Essentials, Sandrift 137

d. Sheet Vinyl:
F301; Mannington: Bio-Spec, Oyster White 15101
F302; Mannington; Bio-Spec, Charcoal 15144

NOTE:
See Arch. Drwg. I-03 for pattern in Medical A312 and Dental A313

h. Ceramic Tile:
F401; Dal-tile; Keystones, Almond D035, 2" x 2"

i. Porcelain Tile:
F501: Dal-tile; Rocky Mountian, Nero 806 Unpolished, 12" x 12"
F502: Dal-tile; Rocky Mountain, Bianco 801 Unpolished, 12" x 12"

NOTE:
See Arch. Drwgs A29, A30, A31 for porcelain tile F501 and F502 installation areas.

Floor Tile, F501, shall be installed in Dal-tile Brickwork Square Pattern.
Floor Tile, F502, shall be installed in Men and Women Toilet Areas in a 45 degree angle.

j. Grout:
M401; Custom Bldg. Products; New Taupe

2.2.5 Interior Base Finishes

Base materials shall be provided to match the colors listed below.

a. Resilient Base and Edge Strips:
B101; Johnsonite, Tightlock, TCB 20, Charcoal, 4".
AM#1 B102; Johnsonite, Cove, 24 **Moon** Rock, 4"

c. Ceramic Tile:
B201; Dal-tile; Keystones, Almond 035, MB-5A.

d. Porcelain Tile:
B301; Dal-tile; Rocky Mountain, Nero Bullnose, S44C9
AM#1 B302; Dal-tile; Rocky Mountain, Bianco, Bullnose, S44C9

e. Grout:
M401; Custom Bldg. Products; New Taupe

2.2.6 Interior Wall Finishes

Interior wall color shall apply to the entire wall surface, including reveals, vertical furred spaces, grilles, diffusers, electrical and access panels, and piping and conduit adjacent to wall surfaces unless otherwise specified. Items not specified in other paragraphs shall be painted to match adjacent wall surface. Wall materials shall be provided to match the colors listed below.

a. Paint:
W101; Sherwin Williams; Canvas Tan 1129
W102; Sherwin Williams; Neutral Ground 1130

NOTE:
Paint to be applied over Wall Texture that shall match USG; Knock-Down & Skip Trowel or approved equal.

b. Vinyl Wall Covering:
W201; Tri-kes; VP02-5080

AM#1
c. Porcelian Tile
W301; Dal-tile; Rocky Mountain, Bianco 801, 12" X 12"
W302; Dal-tile; Rocky Mountain, Nero 806, 6" x 12"

NOTE: See Arch. Drwg. A29 for wall pattern details.

d. Ceramic Tile:
W401; Dal-tile; Keystones, Porcelain, 2" x 2"

e. Ceramic Tile Grout:
M401; Custom Bldg. Products; New Taupe

f. Acoustical Wall Covering:
AM#1 W901; Tri-kes; Overture; Malibu 7005

AM#3
h. Acoustical Wall Panels:
W501; USG; Silent Touches; Fabric-Guilford of Maine, **Bailey 2299, 010 Belmont Silver**

NOTE:
SEE ARCH. DRWGS. I-06 AND I-07 FOR ACOUSTICAL WALL PANEL DETAILS.

2.2.7 Interior Ceiling Finishes

Ceiling colors shall apply to ceiling surfaces including soffits, furred down areas, grilles, diffusers, registers, and access panels. Ceiling color shall also apply to joist, underside of roof deck, and conduit and piping where joists and deck are exposed and required to be painted. Ceiling materials shall be provided to match the colors listed below.

a. Acoustical Tile and Grid:
C301; Armstrong; Fine Fissured Open Plan, Med. Texture, White

b. Paint:
C201; Sherwin Williams; Canvas Tan 1129
C202; Sherwin Williams; Neutral Ground, 1130

c. Vault
C302; Sherwin Williams; Metalworks Vault/Aluminum, Perforated White

2.2.8 Interior Trim

Interior trim shall be provided to match the colors listed below.

a. Doors:
D101; Sherwin Williams; Canvas Tan 1129
AM#1 D201: Graham **Arch.** Products, Antique Bronze

b. Door Frames:
T101; Sherwin Williams; Canvas Tan 1129
AM#1 T201; Graham **Arch.** Products, Antique Bronze

c. Windows (mullion, muntin, sash, trim, and stool):
AM#1 Graham **Arch.** Products, Antique Bronze

d. Window Sills:
Sherwin Williams; Canvas Tan 1129

e. Fire Extinguisher Cabinets:
AM#1 To Match Graham **Arch.** Products, Antique Bronze

f. Handrails:
Sherwin Williams, Canvas Tan 1129

g. Ladders: [_____].

h. Metal Stairs:
Sherwin Williams, Canvas Tan 1129

2.2.9 Interior Window Treatment

Window treatments shall be provided to match the colors listed below.

a. Shadecloth:
M301; Mecho, Euroveil, Graphite 5311

2.2.10 Interior Miscellaneous

Miscellaneous items shall be provided to match the colors listed below.

a. Toilet Partitions and Urinal Screen:
M201; Santana, Black

b. Plastic Laminate:
PL-1; Wilsonart; Canyon 1754-60
NOTE:
Countertop and Base B104

PL-2; Wilsonart; Bronze Legacy 4656-60
NOTE:
Countertop and Base Locations as indicated in Arch. Drwgs, Rooms A104Q, B209, B209B, B306A, B306B

PL-3: Wilsonart; Chemsurt, Greystone 4790-60
NOTE:
Countertop and Base locations as indicated in Arch Drwgs, Rooms A312A, A312B
Countertop and Backsplash locations as indicated in Arch Drwgs, Rooms A312Q, A312U, A312V

c. Signage Message Color (excluding handicapped signage):
White

d. Signage Background Color (excluding handicapped signage):
Black

e. Lockers:
M101; Penco, 028 Black

f. Operable Partitions:
Kwik-Wall; Maharam, Teck-Wall 1000, Mintless 179

g. Corner Guards:
Korseal; K-8 Cream

h. Wall Switch Handles and Standard Receptacle Bodies:
Stainless Steel

i. Electrical Device Cover Plates and Panels:
Stainless Steel

j. Casework:
See Arch Drwgs. and Plastic Laminate.

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 13121

METAL BUILDING SYSTEMS (MINOR REQUIREMENTS)
AM #0003

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.

ALUMINUM ASSOCIATION (AA)

AA Design Manual	(1994) Aluminum Design Manual: Specification & Guidelines for Aluminum Structures

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Spec	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design
AISC Pub No. S342 L	(1993) Load and Resistance Factor Design Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 252	(1998) Welded and Seamless Steel Pipe Piles
ASTM A 463/A 463M	(1997a) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1999) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 529/A 529M	(1996) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 570/A 570M	(1998) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

ASTM A 572/A 572M	(1999) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(1997) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606	(1998) Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 607	(1998) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
ASTM A 618	(1999) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 653/A 653M	(1999) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	(1997) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 241/B 241M	(1996) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 308/B 308M	(1996) Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B 429	(1995) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 991	(1998) Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 2244	(1995) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 84	(1998e1) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel

CORPS OF ENGINEERS, HUNTSVILLE CENTER (CEHNC)

TI 809-04	(1998) Seismic Design for Buildings
TI 809-07	(1998) Design of Cold-Formed Load Bearing Steel Systems and Masonry Veneer/Steel Stud Walls

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA Low Rise Manual	(1996) Low Rise Building Systems Manual

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100 (1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 580 (1994; Rev thru Feb 1999) Tests for Uplift Resistance of Roof Assemblies

1.2 GENERAL REQUIREMENTS

The metal building system covered under this specification shall be provided by a single manufacturer and shall include all components and assemblies that form a building.

1.2.1 Building Configurations

Roof slope shall be 1-inch in 12-inches. Buildings shall be single-span structures with one of the following framing systems: self-framing or rigid frame. Exterior doors louvers and rolling doors shall be included in the metal building system. Building shall be a manufacturer's advertised product, except that dimensions shall be not less than those indicated. The dimensions shown on the drawings are outsid to outside of the foundation.

1.2.2 Qualifications

1.2.2.1 Manufacturer

Metal building shall be the product of a recognized steel building systems manufacturer who has been in the practice of manufacturing steel buildings for a period of not less than 5 years. The manufacturer shall be chiefly engaged in the practice of designing and fabricating metal building systems.

1.2.2.2 Installer

Erector shall have specialized experience in the erection of steel building systems for a period of at least 3 years. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads acting on the exposed framing, such as wind loads and seismic forces, as well as loads due to erection equipment and erection operation. Structural members shall not be field cut or altered. Welds, abrasions, and surfaces not shop primed shall be primed after erection.

1.3 DESIGN REQUIREMENTS

Criteria and definitions shall be in accordance with MBMA Low Rise Manual, except criteria for seismic loads shall be in accordance with TI 809-04 and other loads and load combinations in accordance with ASCE 7.

1.3.1 Foundations

Foundations shall be designed for an allowable soil bearing pressure of 2000 _ psf, a minimum bottom of footing depth of 2_feet below finish floor elevation, a factor of safety of 1.5 for overturning, sliding and uplift, and a concrete compressive strength as specified in Section 03300

CAST-IN-PLACE STRUCTURAL CONCRETE.

1.3.2 Structural Members and Connections

Structural steel members and their connections shall be designed in accordance with AISC ASD Spec or AISC Pub No. S342 L. Structural cold-formed steel framing members and their connections shall be designed in accordance with TI 809-07. Framed openings shall be designed to structurally replace the covering and framing displaced.

1.3.3 Roofing and Siding Design

Steel roofing and siding shall be designed in accordance with MBMA Low Rise Manual.

1.3.4 Gutters And Downspouts

Gutters and downspouts shall be designed according to the requirements of SMACNA Arch. Manual for storms which should be exceeded only once in 5 years, with adequate provision for thermal expansion and contraction.

1.3.5 Louvers

Louvers shall be fixed-blade type designed for a minimum net open area of 22_square feet, to be rainproof, and to resist vibration when air is passed at the rate of 6600cubic feet per minute.

1.3.6 Grounding and Lightning Protection

Grounding and lightning protection shall be provided as specified in Section 13100 LIGHTNING PROTECTION SYSTEM.

1.4 DESIGN ANALYSIS

The Contractor shall obtain the services of a licensed Professional Engineer to design the foundations. Seismic loads shall be computed in accordance with TI 809-04 SEISMIC DESIGN FOR BUILDINGS.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Instruction Manuals; GA_____.

Manufacturer's literature for individual building component systems.

SD-04 Drawings

Metal Building Systems; GA_____.

Detail drawings consisting of catalog cuts, design and erection drawings.

SD-08 Statements

Qualifications; GA_____.

Qualifications of the manufacturer, and qualifications and experience of the building erector. A brief list of locations where buildings of similar design have been used shall be included with the detail drawings and shall also include information regarding date of completion, name and address of owner, and how the structure is used.

SD-13 Certificates

Metal Building Systems; GA_____.

a. A Certificate from the metal building manufacturer stating that the metal building was designed in accordance with MBMA Low Rise Manual.

b. Mill certification for structural bolts, framing steel, roofing and siding, and steel wall liner panels.

c. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 5 year Warranty for Metal Building Roof System, a sample copy of which is attached to this section, the 20-year Manufacturer's Material Warranties, and the Manufacturer's 20-year System Weathertightness Warranty where one is required.

1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials other than framing and structural members shall be covered with weathertight coverings and kept dry. Storage accommodations for roofing and siding shall provide good air circulation and protection from surface staining.

1.7 WARRANTIES

The Metal Building System (roofing, siding, and related components provided as part of the system) shall be warranted as described below against material and workmanship deficiencies, system deterioration caused by ordinary exposure to the elements and service design loads, leaks and wind uplift damage. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.7.1 Prime Contractor's Weathertightness Warranty

The Metal Building System shall be warranted by the Contractor on a no penal sum basis for a period of five years against materials and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The Metal Building System covered under this warranty shall include, but is not limited to, the following: framing and structural members, roofing and siding panels and seams, interior or exterior gutters and downspouts, accessories, fasteners, trim,

flashings and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer), connectors, components, and fasteners, and other system components and assemblies installed to provide a weathertight system; and items specified in other sections of these specifications that become part of the metal building system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's written warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and/or system manufacturer, which shall be submitted along with Contractor's warranty. However, the Contractor is ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached **WARRANTY FOR METAL BUILDING SYSTEMS**, and start upon final acceptance of the facility. The Contractor shall provide a separate bond in an amount equal to the installed total metal building system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire metal building system as outlined above.

1.7.2 Manufacturer's Materials and System Weathertightness Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties to the Contracting Officer which cover all Metal Building System components:

a. A manufacturer's 20 year material warranty warranting that the specified aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed securement system, including fasteners and coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214test procedures; or change colors in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to replacing the defective coated material.

PART 2 PRODUCTS

2.1 FRAMING AND STRUCTURAL MEMBERS

Steel 1/8 inch or more in thickness shall conform to ASTM A 36/A 36M, . Uncoated steel less than 1/8 inch in thickness shall conform to ASTM A 570/A 570M, ASTM A 606, or ASTM A 607. Galvanized steel shall conform to ASTM A 653/A 653M, G 90 coating designation, 0.045 inch minimum thickness.
Structural pipe shall conform to ASTM A 53, ASTM A 252, ASTM A 500, ASTM A 501, ASTM A 618, ASTM B 221, ASTM B 241/B 241M or ASTM B 429. Holes for

structural connections shall be made in the shop.

2.2 ROOFING AND SIDING

Roofing and siding shall be steel and shall have a factory color finish.

2.2.1 Roofing

Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope unless otherwise approved. Width of sheets with interlocking ribs shall provide not less than12 inches of coverage in place. Panel shall have configurations for overlapping sheets. Roof deck assemblies shall be Class 90 as defined in UL 580. Height of corrugation at overlap of adjacent roof sheets shall be the building manufacturer's standard.

2.2.2 Siding

Length of sheet shall be sufficient to cover the entire height of any unbroken height of wall surface unless otherwise approved. Width of sheets with interlocking ribs shall provide not less than 12 inches of coverage in place. Siding shall have interlocking ribs for securing adjacent sheets. Siding shall be fastened to framework using concealed fasteners.

2.2.3 Steel Panels

Roofing and Siding shall be zinc-coated steel conforming to ASTM A 653/A 653M, G 90 coating designation; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2E5. Panels shall be 0.024 inch thick minimum.

2.2.4 Factory Color Finish

Wall and roof panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated in Section 09915: COLOR SCHEDULE. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The interior finish shall consist of the manufacturer's recommended thickness primer coating.

2.2.5 Accessories

Flashing, trim, metal closure strips and curbs, fascia, caps, diverters, and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the building finish. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the roofing or siding and shall not absorb or retain water.

2.3 FASTENERS

Fasteners shall be as recommended by the manufacturer to meet the design strength requirements.

2.4 DOORS

2.4.1 Hinged Doors

Hinged doors and frames shall receive a galvanic coating and factory primer and shall conform to the requirements of Section 08110 STEEL DOORS AND FRAMES. Exterior doors shall have top edges closed flush and sealed against water penetration. Hardware shall be as specified in Section 08700 BUILDERS' HARDWARE, Hardware set #4 for a 3-foot by 7-foot steel door and frame.

2.4.2 Overhead Rolling Doors

Overhead rolling doors shall conform to the requirements of Section 08330 OVERHEAD ROLLING DOORS. Hardware shall be as specified in Section 08700 BUILDERS' HARDWARE.

2.5 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be [colored to match the applicable building color] [clear] and shall cure to a rubber like consistency.

2.6 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.7 SHOP PRIMING

Ferrous surfaces shall be cleaned of oil, grease, loose rust, loose mill scale, and other foreign substances and shop primed. Primer coating shall be in accordance with the manufacturer's standard system.

PART 3 EXECUTION

3.1 ERECTION

Dissimilar materials which are not compatible when contacting each other shall be insulated from each other by means of gaskets or insulating compounds. Improper or mislocated drill holes in panels shall be plugged with an oversize screw fastener and gasketed washer; however, panels with an excess of such holes or with such holes in critical locations shall not

be used. Exposed surfaces shall be kept clean and free from sealant, metal cuttings, excess material from thermal cutting, and other foreign materials. Exposed surfaces which have been thermally cut shall be finished smooth within a tolerance of 1/8 inch. Stained, discolored or damaged sheets shall be removed from the site. Welding of steel shall conform to AWS D1.1; welding of aluminum shall conform to AA Design Manual.

3.1.1 Framing Members and Anchor Bolts

Onsite flame cutting of framing members, with the exception of small access holes in structural beam or column webs, will not be permitted. Concrete work is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Anchor bolts shall be accurately set by template while the concrete is in a plastic state. Members shall be accurately spaced to assure proper fitting of panels. As erection progresses, the work shall be securely fastened to resist the dead load and wind and erection stresses.

3.1.2 Roofing and Siding Installation

Siding shall be applied with the longitudinal configurations in the vertical position. Roofing shall be applied with the longitudinal configurations in the direction of the roof slope. Accessories shall be fastened into framing members, except as otherwise approved. Closure strips shall be provided where necessary to provide weathertight construction. Fastener and fastener spacing shall be in accordance with manufacture design.

3.1.3 Installation of Gutters and Downspouts

Gutters and downspouts shall be rigidly attached to the building. Spacing of cleats for gutters shall be 16 inches maximum. Spacing of brackets and spacers for gutters shall be 36 inches maximum. Supports for downspouts shall be spaced according to manufacturer's recommendations.

3.1.4 Louvers

Louvers shall be rigidly attached to the supporting construction to assure a weather tight installation.

3.1.5 Doors

Doors including frames and hardware, shall be securely anchored to the supporting construction, shall be installed plumb and true, and shall be adjusted as necessary to provide proper operation. Joints at doors and windows shall be sealed according to manufacturer's recommendations to provide weathertight construction.

3.2 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

3.3 FIELD PAINTING

Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used

for the shop coat. Shop-primed ferrous surfaces exposed on the outside of the building and all shop-primed surfaces of doors and windows shall be painted with two coats of an approved exterior enamel. Factory color finished surfaces shall be touched up as necessary with the manufacturer's recommended touch-up paint.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM

FACILITY DESCRIPTION:_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____
ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____
ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____
ADDRESS:_____

POINT OF CONTACT:_____
_
TELEPHONE NUMBER:_____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE METAL BUILDING SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY [_____] FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE AND STRUCTURAL FAILURE WITHIN PROJECT SPECIFIED DESIGN LOADS, AND LEAKAGE. THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT IS NOT LIMITED TO, THE FOLLOWING: FRAMING AND STRUCTURAL MEMBERS, ROOFING AND SIDING PANELS AND SEAMS, INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS, ACCESSORIES, TRIM, FLASHINGS AND MISCELLANEOUS BUILDING CLOSURE ITEMS SUCH AS DOORS AND WINDOWS (WHEN FURNISHED BY THE MANUFACTURER), CONNECTORS, COMPONENTS, AND FASTENERS, AND OTHER SYSTEM COMPONENTS AND ASSEMBLIES INSTALLED TO PROVIDE A WEATHERTIGHT SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THESE SPECIFICATIONS THAT BECOME PART OF THE METAL BUILDING SYSTEM. ALL MATERIAL AND WORKMANSHIP DEFICIENCIES, SYSTEM DETERIORATION CAUSED BY EXPOSURE TO THE ELEMENTS AND/OR INADEQUATE RESISTANCE TO SPECIFIED SERVICE DESIGN LOADS, WATER LEAKS AND WIND UPLIFT DAMAGE SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE ASSOCIATED WITH THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON [_____] AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

_____

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE METAL BUILDING SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL,INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE BUILDING SYSTEM DUE TO ACTIONS BY THE OWNER WHICH INHIBIT FREE DRAINAGE FROM THE ROOF, GUTTERS AND DOWNSPOUTS; OR CONDITIONS WHICH CREATE PONDING WATER ON THE ROOF OR AGAINST THE BUILDING SIDING.

6. THIS WARRANTY APPLIES TO THE METAL BUILDING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES. REPORTS OF LEAKS AND BUILDING SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE BY TELEPHONE OR IN WRITING FROM EITHER THE OWNER, OR CONTRACTING OFFICER. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(Exclusions from Coverage Continued)

IN THE CONTRACTAND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE METAL BUILDING SYSTEM REPLACED OR REPAIRED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR. IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION, UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED THE PARTIES SHALL, WITHIN 10 DAYS JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN 10 DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

SECTION 13930

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

AMENDMENTS NO. 0001 AND 0002 AND 0003

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 47	(1990; R 1995) Ferritic Malleable Iron Castings
ASTM A 47M	(1999) Ferritic Malleable Iron Castings Metric)
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 135	(1997c) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1998) Carbon Steel Track Bolts and Nuts
ASTM A 536	(1999el) Ductile Iron Castings
ASTM A 795	(1997) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM F 442/F 442M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1998) Cast Iron Threaded Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings

ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B18.2.1	(1996) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)

AMERICAN SOCIETY OF SANITARY ENGINEERING FOR PLUMBING AND SANITARY RESEARCH (ASSE)

ASSE 1015	(1993) Double Check Backflow Prevention Assembly

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA EWW	(1995) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C203	(1997) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(1996; Errata 13-96-1) Automatic Sprinkler Systems
NFPA 13R	(1996) Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 231C	(1998) Rack Storage of Materials
NFPA 1963	(1998) Fire Hose Connections

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL 668	(1995; Rev thru Dec 1998) Hose Valves For Fire Protection Service
UL Bld Mat Dir	(1999) Building Materials Directory
UL Fire Prot Dir	(1999) Fire Protection Equipment Directory

1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in all areas of the building . The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13 . . Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. The Contractor shall design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density [AM#3] as indicated on the drawings. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13.

1.2.1.1 Hose Demand

An allowance for exterior hose streams of 250 gpm shall be added to the sprinkler system demand at the point of connection to the existing system. An allowance for interior hose stations of 100 gpm shall also be added to the sprinkler system demand.

1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply with a static pressure of 51, and a flow of 1010 at a residual pressure of 49. Water supply shall be presumed available at the point of connection to existing . Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 100for existing underground piping.

1.2.2 Sprinkler Spacing

Sprinklers shall be uniformly spaced on branch lines. Maximum spacing per sprinkler shall not exceed 225 square feet and 130 square feet for ordinary hazard.

1.3 COORDINATION OF TRADES

Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.5 FIELD MEASUREMENTS

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. Submittals related to system configuration, hydraulic calculations, and equipment selection, including manufacturer's catalog data, working

drawings, connection drawings, control diagrams and certificates shall be submitted concurrently as a complete package. The package will be reviewed by the U.S. Army Engineer District Fire Protection Engineer. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Fire Protection Related Submittals; FIO.

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

Components and Equipment Data; GA.

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; GA.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

Spare Parts; FIO.

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

SD-04 Drawings

Sprinkler System Drawings; GA.

Three copies of the Sprinkler System Drawings, no later than 21 days prior to the start of sprinkler system installation. The Sprinkler System Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, sway bracing, inspector's test connections, drains, and other

applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

As-Built Drawings; FIO.

As-built drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be submitted on both lectronic file utilizing .dgn file format andreproducible full-size mylar film.

SD-06 Instructions

Preliminary Tests Procedures; GA.

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests.

Final Acceptance Test Procedures; GA.

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests.

SD-07 Schedules

On-site Training Schedule; GA.

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

Preliminary Tests; GA.

Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

Final Acceptance Test; GA.

Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

SD-08 Statements

Fire Protection Specialist Qualifications; GA.

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer Qualifications; GA.

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

SD-09 Reports

Preliminary Tests Report; GA.

Three copies of the completed Preliminary Tests Reports, no later that 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Test Report; GA.

Three copies of the completed Final Acceptance Tests Reports, no later that 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

SD-13 Certificates

Fire Protection Specialist Inspection; GA.;

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

SD-19 Operation and Maintenance Manuals

Wet Pipe Sprinkler System; GA.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

1.7 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.9 SPRINKLER SYSTEM INSTALLER QUALIFICATIONS

Work specified in this section shall be performed by the Sprinkler System Installer. The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this

specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe

Piping from the backflow preventer to a point 5 feet outside the building wall shall be ductile iron with a rated working pressure of 175 psi conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Piping more than 5 feet outside the building walls shall comply with Section 02510 WATER DISTRIBUTION SYSTEM.

2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

2.4.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b. AM #0002 Gate valves and indicator posts shall be supervised with a valve supervisory (tamper) switch as specified below.

2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel .

2.5.1 Steel Piping Components

2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Galvanized fittings shall be used for piping systems or portions of piping systems utilizing galvanized piping. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.5.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type. Bolts shall conform to ASME B18.2.1 and nuts shall be hexagon type conforming to ASME B18.2.2.

2.5.2 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and sized involved.

2.5.3 Valves

2.5.3.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in [AM#1]UL Fire Prot Dir or FM P7825a and FM P7825b.

2.5.3.2 Check Valve

Check valve 2 inches and larger shall be listed in [AM#1]UL Fir Prot Dir

or FM P7825a and FM P7825b. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5.3.3 Hose Valve

Valve shall comply with UL 668 and shall have a minimum rating of 300 psi. Valve shall be non-rising stem, all bronze, 90 degree angle type, with 2-1/2 inch American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 2-1/2 to 1-1/2 inch reducer. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain. Valve finish shall be polished chrome plated.

2.6 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

2.7 WATERFLOW ALARM

Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control Panel(FACP) in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

2.8 ALARM INITIATING AND SUPERVISORY DEVICES

2.8.1 Sprinkler Waterflow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 10 gpm or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

2.8.2 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.9 FIRE DEPARTMENT CONNECTION

Fire department connection shall be flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a chromium plated finish. The connection shall have two inlets with individual self-closing

clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963 .

2.10 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed spacing limitations. Temperature classification shall be ordinary . Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Orifice of extended coverage sprinklers shall not exceed 17/32 inch.

2.10.1 Concealed Sprinkler

Concealed sprinkler shall be white polyester and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.2 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, quick-response type with nominal 1/2 inch orifice. Pendent sprinklers shall have a white polyester finish.

2.10.3 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.4 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 1/2 inch orifice. Sidewall sprinkler shall have a polished chrome finish. Sidewall sprinkler shall be the quick-response type.

2.10.5 Corrosion Resistant Sprinkler

Corrosion resistant sprinkler shall be the pendent type installed in locations as indicated. Corrosion resistant coatings shall be factory-applied by the sprinkler manufacturer.

2.11 DISINFECTING MATERIALS

2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.12 ACCESSORIES

2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be

representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.12.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.12.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.12.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located as indicated.

2.12.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

2.13 FLOW TEST EQUIPMENT

The test kit shall consist of one 4 1/2" chrome plated pitot tube; one 2" chrome plated pitot tube; an extended air chamber; a 2 1/2" chrome plated, dual tapped hydrant cap; a double bleeder valve assembly with brass knobs; a cleanable, 3 piston pressure snubber; **two** inspector's pressure test gauges (oil filled) with 3" dials, removal cap over bezel, a .5% accuracy over the full scale, and a recalibrator screw for zero adjustment; and a universal hydrant wrench. All components (except the hydrant wrench) shall come and fit in a polypropylene pin hinged carrying case with contoured interior foam. AM #0002 Test kit shall be turned over to the Fort Hood Fire Department upon completion of work.

2.14 O&M STORAGE CABINET

The cabinet shall be an industrial grade, gray colored, preassembled unit with a 16 gauge steel frame; 22 gauge steel sides, back, bottom, and shelves; and 20 gauge top and doors. The doors shall have partially concealed, heavy duty, four knuckle steel butt hinges and a three point locking mechanism. **Lock shall be keyed to duplicate mechanical room door**. Shelves (2 each) shall be 24" deep with a 200 lb load rating. Shelves shall be capable of repositioning on 2" increments seating firmly on sturdy, welded strips. The free standing cabinet shall measure 36" wide x 24" deep x 42" high.

2.15 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 175 psi The maximum pressure loss shall be 6 psi at a flow rate equal to the sprinkler water demand, at the location of the assembly.

PART 3 EXECUTION

3.1 FIRE PROTECTION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 231C.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

3.4.1 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.2 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.3 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe

with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

3.4.3.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

3.4.4 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

3.4.5 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer.

3.4.6 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

3.4.7 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide

required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes pass through fire walls, fire partitions, or floors, a fire seal shall be placed between the pipe and sleeve in accordance with Section 07840 FIRESTOPPING. In penetrations which are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement which will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.8 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.9 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch pipe connected at the riser as a combination test and drain valve; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

3.4.10 Drains

Main drain piping shall be provided to discharge at a safe point outside the building and shall be installed in a manner such that no damage will not cause damage to adjacent construction or landscaping during full flow discharge. Auxiliary drains shall be provided as required by NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Where branch lines terminate at low points and form trapped sections, such branch lines shall be manifolded to a common drain line.

3.4.11 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade . The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

3.4.12 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3 feet. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished

floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Section 02510 WATER DISTRIBUTION SYSTEM.

3.6 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02315 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

3.7 ELECTRICAL WORK

Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851 Fire Alarm and Detection system, Addressable Wiring color code shall remain uniform throughout the system.

3.8 DISINFECTION

After all system components are installed and hydrostatic test(s) are successfully completed, each portion of the sprinkler system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. Flushing shall be conducted by removing the flushing fitting of the cross mains and of the grid branch lines, and then back-flushing through the sprinkler main drains. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system if filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After the successful completion, all sprinklers or plugs and gravity flush all drops or trapped piping.

3.9 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.10 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

3.10.1 Underground Piping

3.10.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system.

3.10.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

3.10.2 Aboveground Piping

3.10.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.10.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

3.10.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be measured using the flow test equipment furnished under paragraph 2.13 andrecorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.11 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.

3.12 ON-SITE TRAINING

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete but prior to the Preliminary Tests and Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

SECTION 15400

PLUMBING, GENERAL PURPOSE

08/94
ADMENDMENT NO. 0001
ADMENDMENT NO. 0002
AMENDMENT NO. 0003

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.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 700	(1995; Apx C) Specifications for Fluorocarbon and Other Refrigerants
ARI 1010	(1994) Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.1	(1993; Z21.10.1a; Z21.10.1b; Z21.10.1c) Gas Water Heaters Vol. I Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
ANSI Z21.10.3	(1998) Gas Water Heaters Vol. III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous Water Heaters
ANSI Z21.22	(1986; Z21.22a) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems
ANSI Z21.56	(1994; Z21.56a) Gas-Fired Pool Heaters

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990; R 1995) Ferritic Malleable Iron Castings
ASTM A 47M	(1990; R 1996) Ferritic Malleable Iron Castings (Metric)
ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 74	(1998) Cast Iron Soil Pipe and Fittings
ASTM A 105/A 105M	(1998) Carbon Steel Forgings for Piping Applications
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(1999) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 515/A 515M	(1997) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(1990; R 1996) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518	(1992; R 1997) Corrosion-Resistant High-Silicon Iron Castings
ASTM A 518M	(1992; R 1997) Corrosion-Resistant High-Silicon Iron Castings (Metric)
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 733	(1999) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 888	(1998) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 32	(1996) Solder Metal
ASTM B 42	(1996) Seamless Copper Pipe, Standard Sizes
ASTM B 43	(1996) Seamless Red Brass Pipe, Standard Sizes
ASTM B 75	(1997) Seamless Copper Tube
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM B 111	(1998) Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
ASTM B 117	(1997) Operating Salt Spray (FOG) Apparatus
ASTM B 152	(1997a) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 152M	(1997a) Copper Sheet, Strip, Plate, and Rolled Bar (Metric)

ASTM B 306	(1996) Copper Drainage Tube (DWV)
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM B 584	(1998a) Copper Alloy Sand Castings for General Applications
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(1998) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1053	(1990; R 1995el) Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM D 638	(1998) Tensile Properties of Plastics
ASTM D 638M	(1998) Tensile Properties of Plastics (Metric)
ASTM D 1004	(1994a) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1248	(1984; R 1989) Polyethylene Plastics Molding and Extrusion Materials
ASTM D 1785	(1996b) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 2235	(1996a) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2239	(1996a) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2241	(1996b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	(1995) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter

ASTM D 2464	(1996a) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1997) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1998a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2485	(1991; R 1996) Evaluating Coatings for High Temperature Service
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1997) Heat Fusing Joining Polyolefin Pipe and Fittings
ASTM D 2661	(1997a) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(1998) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1996a) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(1998) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	(1996a) Polyethylene (PE) Plastic Tubing
ASTM D 2822	(1991; R 1997el) Asphalt Roof Cement
ASTM D 2846/D 2846M	(1997) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3035	(1995) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3122	(1995) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(1995) Solvent Cements for Transition

	Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(1997) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM D 3311	(1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D 4060	(1995) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4101	(1996a) Propylene Plastic Injection and Extrusion Materials
ASTM D 4551	(1996) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
ASTM E 1	(1998) ASTM Thermometers
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM F 409	(1998) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 437	(1997) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(1997) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(1998) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441/F 441M	(1997) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442/F 442M	(1997) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

ASTM F 477	(1996a) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(1997) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 628	(1997ael) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F 891	(1998) Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
ASTM F 1290	(1998a) Electrofusion Joining Polyolefin Pipe and Fittings
ASTM F 1760	(1997) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastuc Pipe Having Reprocessed-Recycled Content

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 34	(1992; Addenda a-j) Number Designation and Safety Classification of Refrigerants
ASHRAE 90.1	(1989; 90.1b; 90.1c; 90.1d; 90.1e; 90.1g; 90.1i; 90.1l-1995; 90.1m-1995; 90.1n-1997) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(1991; R 1998) Air Gaps in Plumbing Systems
ASME A112.6.1M	(1997) Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.14.1	(1975; R 1998) Backwater Valves
ASME A112.18.1M	(1996) Plumbing Fixture Fittings
ASME A112.19.1M	(1994; Errata 97, Supplement 1998) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	1998 Vitreous China Plumbing Fixtures
ASME A112.19.3M	(1987; R 1996) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
ASME A112.19.4M	(1994; 1997 and 1998) Porcelain Enameled Formed Steel Plumbing Fixtures
ASME A112.21.1M	(1991; R 1998) Floor Drains
ASME A112.21.2M	(1983) Roof Drains

ASME A112.36.2M	(1991; R 1998) Cleanouts
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Gray Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.12	(1998) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(1992; Errata Jan 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(1991; R 1998) Cast Copper Alloy Pipe Flanges, Class 150, 300, 400, 600, 900, 1500, and 2500, and Flanged Fittings, Class 150 and 300
ASME B16.29	(1994) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.34	(1997) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1986; R 1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B19.3	(1991; B19.3a; B19.3b) Safety Standard for Compressors for Process Industries
ASME B31.1	(1998) Power Piping
ASME B31.5	(1992; B31.5a) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME CSD-1	(1998) Controls and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE 1002	(1986) Water Closet Flush Tank Ball Cocks
ASSE 1003	(1995) Water Pressure Reducing Valves for Domestic Water Supply Systems
ASSE 1005	(1986) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size
ASSE 1006	(1989) Residential Use (Household) Dishwashers
ASSE 1011	(1995) Hose Connection Vacuum Breakers
ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1993) Reduced Pressure Principle Backflow Preventers
ASSE 1018	(1986) Trap Seal Primer Valves Water Supply Fed
ASSE 1037	(1990; Rev thru Mar 1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA EWW	(1995) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C105	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C203	(1997) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1997) Grooved and Shouldered Joints

AWWA C700	(1995) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA D100	(1996) Welded Steel Tanks for Water Storage
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(1997) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1997) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI HSN-85	(1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

CODE OF FEDERAL REGULATIONS (CFR)

10 CFR 430	Energy Conservation Program for Consumer Products
21 CFR 175	Indirect Food Additives: Adhesives and Components of Coatings

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-240	(Rev A) Shower Head, Ball Joint
CID A-A-50012	(Basic) Garbage Disposal Machine, Commercial

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA Tube Handbook	(1995) Copper Tube Handbook

COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

CABO A117.1	(1992; Errata Jun 1993) Accessible and Usable Buildings and Facilities

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR)

FCCCHR-01 (1993) Manual of Cross-Connection Control

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5 (1994) Centrifugal Pumps

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANCIAL OFFICIALS

IAPMO Z124.1 (1995) Plastic Bathtub Units

IAPMO Z124.3 (1995) Plastic Lavatories

IAPMO Z124.5 (1997) Plastic Toilet (Water Closets) Seats

IAPMO Z124.9 (1994) Plastic Urinal Fixtures

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25 (1998) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-44 (1996) Steel PipeLine Flanges

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-67 (1995) Butterfly Valves

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends

MSS SP-72 (1992) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-73 (1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings

MSS SP-78 (1998) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

MSS SP-83 (1995) Class 3000 Steel Pipe Unions Socket-Welding and Threaded

MSS SP-85 (1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

MSS SP-110 (1996) Ball Valves Threaded,

	Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC Plumbing Code	(1996) National Standard Plumbing Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3; Rev 4) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(1997; TIA 97-1) Installation of Oil Burning Equipment
NFPA 54	(1996; Errata) National Fuel Gas Code
NFPA 90A	(1996) Installation of Air Conditioning and Ventilating Systems
NFPA 99	(1999) Health Care Facilities

NATIONAL SANITATION FOUNDATION (NSF)

NSF 3	(1996) Commercial Spray-Type Dishwashing and Glasswashing Machines
NSF 5	(1992) Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
NSF 14	(1998) Plastics Piping Components and Related Materials

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01	(1991) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G-101	(1996) Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data
PDI WH 201	(1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J 1508	(1997) Hose Clamps

THE SOCIETY FOR PROTECTIVE COATING (SSPC)

SSPC SP 5/NACE 1	(1994) White Metal Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 174	(1996; Rev thru Nov 1997) Household Electric Storage Tank Water Heaters
UL 430	(1994; Rev thru Oct 1996) Waste Disposers
UL 732	(1995; Rev Oct 1997) Oil-Fired Storage Tank Water Heaters
UL 749	(1997) Household Dishwashers
UL 921	(1996) Commercial Electric Dishwashers

1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

1.3 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Vibration-Absorbing Features; [__FIO___].

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

SD-04 Drawings

Plumbing System; [__FIO___].

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the

requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Schematics; [___FIO__].

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

SD-06 Instructions

Plumbing System; [__FIO___].

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-09 Reports

Tests, Flushing and Disinfection ; [__FIO___].

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests; FIO.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-13 Certificates

Materials and Equipment; [_FIO____].

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts; [_FIO____].

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

SD-19 Operation and Maintenance Manuals

Plumbing System; [___GA__].

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

1.5 REGULATORY REQUIREMENTS

Plumbing work shall be in accordance with NAPHCC Plumbing Code.

1.6 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

[AM#1]c. Couplings for Grooved Pipe: Ductile Iron ASTM A 536 (Grade 65-45-12).

d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch

thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

e. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.

f. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.

g. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.

h. Solder Material: Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

i. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

j. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.

k. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

l. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 230 degrees F.

m. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

n. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201.

b. Copper, Sheet and Strip for Building Construction: ASTM B 370.

c. Asphalt Roof Cement: ASTM D 2822.

d. Hose Clamps: SAE J 1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Polyethylene Encasement for Ductile-Iron Piping: AWWA C105.

l. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.

m. Thermometers: ASTM E 1.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85

Description	Standard
Vacuum Relief Valves	ASSE 1001
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.3.2 [AM#1] DELETED
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[AM#1]2.3.3 Freeze Proof Wall Hydrants

[AM#1]Freeze-Proof Wall hydrants for mild climates with vacuum-breaker backflow preventer shall have a nickle-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet. [AM#1]Hydrant shall be nominal 5 1/8" in depth to allow installation into brick veneer, steel stud wall assembly.

2.3.4 [AM#1] DELETED

2.3.5 [AM#1] DELETED

2.3.6 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure

and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief [AM#1]valve shall be the size of the valve outlet. A high temperature safety control shall stop firing when the normal operating controls have failed to control the water temperature on WH-08.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with NAPHCC Plumbing Code. Fixtures for use by the physically handicapped shall be in accordance with CABO A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

2.4.1 Lavatories

Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in [AM#1]a manner similar to the hanger plate. Dental area sinks P-10 are stainless steel and are integral with casework. All other lavatories are furnished by the contractor under this construction contract.

2.4.2 Automatic Flushing System

Flushing system shall consist of solenoid-activated flush valve with electrical-operated light beam sensor to energize solenoid. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-01. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded or caulked connection. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.21.1M.

2.6.2 Sight Drains

A sight drain shall be provided at the cooling tower and at AHU-1 AND AHU-2. Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded or caulked connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar	36 square inches
Height of funnel	3-3/4 inches
Diameter of lower portion of funnel	2 inches

Diameter of upper portion of funnel	4 inches

2.6.3 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.21.2M, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 0.134 inch. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.7 TRAPS

Unless otherwise specified, sink traps shall be or copper-alloy adjustable tube type with slip joint inlet and swivel. Drain traps above ceiling or below floor shall be metallic dwv copper or cast iron. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 WATER HEATERS

Water heater types and capacities shall be as indicated. Each primary water heater shall have controls with an adjustable range that includes 90 to 120 degrees F. Each gas-fired water heater, electric and point of use water heaters shall have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems

shall be tied into building off-hour controls. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. Metal type B double wall vent or [AM#1]pressure vent is required, based on listed requiremnt of specific unit.

2.8.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.

2.8.1.1 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.3 for heaters with input greater than 75,000 BTU per hour. WH-08 is selected based on a Turbopower gas packaged heater from PVI Industries with double burners and double heat exchangers model 500-2. Extend 6" dia type B flue up to roof as shown. Flue diameters may be changed and reducers provided to match the [AM#1]vent diameter on the manufacturer's heat exchanger. Atmospheric vacuum breakers shall be provided on the incoming domestic cold water line.

2.8.1.2 Electric Type

Electric type water heaters shall conform to UL 174. Each element(s) shall be as scheduled.. Atmospheric vacuum breakers shall be provided on each incoming domestic cold water line on the 40 gallon electric heaters and the small electric water heaters under the cabinet at each P-9 sink.

2.9 COMPRESSED AIR SYSTEM

[AM#1]2.9.1 Dental Compressed Air System

Air compressors shall conform to ASME B19.3. Medical (oil-free air) compressor installation shall conform to NFPA 99. Air compressor unit shall be a factory packaged assembly, including [3_]-phase, [120/208_] volts motor controls, switches, wiring, accessories, and motor controllers, in a UL listed NEMA 250, Type [1] enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name and catalog number, on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with automatic alternation system. Each compressor motor shall be provided with an across-the-line type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receivers, to remove moisture and oil condensates before the air enters the receiver. Aftercoolers shall be air cooled. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

Initial control setpoint **[AM#2]** 100 psig. This system is a level 3 source and distribution system for powering dental handpiece tools with an additional alarm indication panel.

[AM#1]2.9.1.1 Dental Compressed Air (Oil-Free, Medical Type) Compressors

Compressors shall have the capacity indicated. Compressor shall be reciprocating teflon-ring type designed so that no oil is administered to the air cylinder, the portion of the piston rod that travels in the crankcase section does not travel in any portion of the air-cylinder section, and with provision to prevent the flow of lubrication oil along the piston rod into the air-cylinder section]. A pressure gauge calibrated to 300 psi, and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to the pressure switch. The motor and compressors shall be directly connected or operated by V-belt drive. Compressors shall be sequenced to start automatically when the pressure drops to a preset point. Compressors shall be air cooled.

2.9.1.2 Air Receivers

Air receiver delivering air to dental rooms shall be designed for 125 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPV VIII Div 1, and shall have the design working pressures specified. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

2.9.1.3 Air Dryers

An air dryer shall be provided in the air supply system to dental functions. The dryers shall be installed on the downstream side of the receiver. The dryer shall be capable of drying the maximum anticipated air flow and pressure to a pressure dewpoint of 38 degrees F with entering air at 100 degrees F saturated. The compressed air dryer shall be of the refrigerated type.

2.9.1.4 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 micrometers. Filter body and media shall withstand a maximum 125 psi capacity as indicated.

2.9.1.5 Discharge Air Supply Filter

A high-efficiency type micro-coalescer filter shall be provided on the discharge air line of medical-compressed-air compressors to limit particle size to a maximum of 2 micrometers.

2.9.1.6 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators

shall be designed for a maximum inlet pressure of 125 psi and a maximum temperature of 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure [AM#1]differential from 0 to 125 psig. Initial regulator setpoint is 90 psig.

2.9.1.7 Dewpoint Meter

A dewpoint meter shall be provided to continuously monitor the dewpoint of the dental air. Meter shall meet requirements of NFPA 99.

[AM#1] 2.10 ORAL EVACUATION SYSTEM FOR DENTAL OPERATORIES

2.10.1 High-Volume Oral Evacuation System (VAC-1)

The central VAC system shall be composed of standard manufactured products, complete with devices normally furnished and devices required herein. The central VAC system shall be supplied by an established manufacturer of commercially available, industrial quality vacuum system, as a complete system. The VAC shall be essentially a wet system, composed of two vacuum turbines, each of which shall be sized to support the full VAC requirement. The turbines shall be connected in parallel to the central wet separator tanks. The VAC equipment shall be skid or frame mounted with the separator tank, conrols and interconnecting piping, The unit shall arrive on site factory assembled with only external connections remaining to be completed. Factory represenative shall supervise the correct [AM#2]installation of the unit. This is a level 3 wet piping system with an additional alarm indicator panel

2.10.1.1 Vacuum Turbines

Turbines shall be self-governing, multistage, centrifugal type, of overhung or outboard design. The vacuum producer shall operate at a speed not to exceed 3,600 rpm and shall be connected to its driving motor by a flexible coupling. Bearings may be sealed or of the lubricatable type. A fan shall be connected directly to the vacuum producer shaft adjacent to vacuum producer shaft bearings to create a flow of ambient air over the bearing carrier while the unit is operating. A steel coupling guard encompassing the flexible coupling shall be installed between the motor and vacuum producer. Cases shall be cylindrical in design. Cases and end plates (inlet and exhaust heads included) shall be constructed of either heavy-gauge sheet steel rigidly welded at seams and sections, or of cast grey iron. Sheet steel end plates shall be either concave or convex. Inlet and exhaust connections shall be tangential to the vacuum producer except the inlet connection can be axial to vacuum producer and sized to allow free air movement through the vacuum producer, without flow restriction and shall have class 150 flanges. The vacuum producer input shall have an adjustable volume control valve, a directional flow valve and antisurge valve. The vacuum producer output shall have an exhaust silencer. Plumbing shall be connected to the vacuum producer through flexible sleeve connectors. Internal moving parts shall be constructed with not less than 0.125 inch clearance throughout to prevent damage by transient particulates. Impellers shall be constructed of fabricated sheet metal or high-tensile aluminum alloy, smooth on all surfaces to prevent

imbalance by uneven dust deposits. Impellers shall be of the backward curved or radial design to provide optimal performance over a wide range of volume requirements. Impellers shall be securely attached to the vacuum producer shaft by set screws or clamps of high-tensile material. Each impeller shall be individually balanced. The complete assembly, with motor, shall not exceed 1-1/2 mils of vibration when given a running test. Power to operate the vacuum producer shall be in direct proportion to the volume of air exhausted and shall not exceed the normal motor rating. The vacuum produced shall be substantially constant throughout the operating range of the vacuum producer. Each vacuum producer shall have a minimum capacity, rated in scfm at standard conditions 14.7 psig and 70 degrees F of [150] scfm at [_9_] inch Hg vacuum. The vacuum producer shall be sized to produce the above designated performance standards at the above-sea-level elevation of the proposed installation site, and shall be so certified by the manufacturer by equipment tag or plate, or by letter of certification identifying the vacuum producer by serial number. The motor for the vacuum producer shall be of a standard NEMA MG 1, 3450 rpm, T-frame, dripproof design [120/208v] Vac, 60 Hz, [_3_] phase with either sealed or lubricatable bearings. Operating temperature rise of the motor shall not exceed 72 degrees F. Each vacuum producer assembly shall be mounted on resilient isolator pads as recommended by the manufacturer. The pads shall not be fastened to the facility floor. Vibration transmission shall be limited to less than 5 percent of the lowest frequency of vibration.

2.10.1.2 Pipe Isolators

Flexible, resilient band-sealed (clamped) sleeves shall be furnished to isolate the vacuum producer from associated piping. Sleeve couplings shall be sized in accordance with the exhauster intake and output connections. Pipe isolators shall be provided with steel coupling guards.

2.10.1.3 Valves

a. Volume Control Valve: The input of each vacuum producer shall have an adjustable air volume control valve to prevent accidental vacuum producer overload and to provide a means of adjusting the upper design capacity limit. The volume control valve shall be built in or immediately adjacent to the first or input stage of the vacuum producer and shall be preset by the manufacturer during certification procedure. The valve shall be a butterfly type with cast iron body with corrosive resistant internals.

b. Antisurge Valve: The input of each vacuum producer shall have an antisurge valve that will operate proportionally and automatically throughout the vacuum producer's designed range. This valve shall continually sense the motor current and maintain a predetermined operational level of volume by proportionally bleeding air into the system. The valve shall be equipped with a silencer to attenuate air noise to 85 dB or below. The valve shall be installed in, on, or near the first stage of the vacuum producer and can be mounted in conjunction with the directional flow valve.

c. Directional Flow Valve: The input of each vacuum producer shall have a directional flow valve to prevent back flow of air through the shutdown. The directional flow valve shall be cast iron with corrosive resistant internals.

2.10.1.4 Exhaust:

AM#1 Silencer:
Each vacuum producer shall exhaust to a separate air discharge silencer of the open-bore expansion type. No interior baffling or shrouding will be permitted. The silencer shall satisfactorily attenuate air noise to a level below 85 dB.

[AM#1] Exhaust pipe from Turbines:
[AM#2] Exhaust shall be 4" schedule 40 galvinized pipe with reducers and fitting to match the turbine discharge collar.

2.10.1.5 Controls

The main electric control panel for the system shall consist of the following: combination across-the-line magnetic starters with time-delay fused disconnects, running-hour meters to indicate the number of hours each vacuum producer has been in operation, a manual and automatic alternator to control starting sequence of the vacuum producers on-off-auto selector switch for each vacuum producer, automatic start of standby vacuum producer on system demand, a certified vacuum gauge (inch Hg), red or amber warning lights with audible alarm to indicate shutdown due to fuse failure, and separator tank washdown system timers. Controls shall include a complete low-voltage (24 volts ac) control function with a low-voltage control panel for remote operation and monitoring of the vacuum producers. The remote panel location shall be as shown. The low voltage remote control panel shall contain on-off switch for operation of the vacuum producers, pilot lights to indicate operation, and a certified vacuum gauge (inch Hg) to indicate the vacuum within the system at all times.

2.10.1.6 Central Wet Separator

The VAC-1 system shall utilize a central wet separator. Separator tank shall be constructed of a nonmetallic, noncorrosive, inert material or composite such as glass-reinforced plastic (GRP). Tank shall be of one-piece construction, with smooth, interior walls. Tanks shall be freestanding. One tank shall be provided with each tank having a capacity of [_40__]gallons. Tank shall be high-pressure vessels able to withstand a constant negative pressure of 5 inch Hg. The tops of the tanks may be convex or concave. The bottom of the tank shall be convex with drain at the apex of convexity. The inlet shall be tangential to effect a cyclonic separation of air, water and waste. Separator tank shall be equipped with mechanical overflow protection, which shall be preplumbed with a 360 degree nozzle internal washdown system with timer. The washdown system shall include a 115 volt ac automatic-flush clock-controlled mechanism which shall effect a complete washdown of the interior of the separator at any predetermined time of day or night. Washdown time shall be adjustable for up to at least 3 minutes. The timers shall be in the main electric control panel. The cold water supply to the automatic tank flush unit shall be equipped with an in-line filter with 40-mesh stainless steel screens. Filter shall be supplied as part of the VAC system. Separator tank shall be equipped with an electronic high-low liquid level sensor which shall perform as the primary overfill protector. Each sensor shall control a 115 volt ac electrically operated output air solenoid valve located to control the outgoing air from the tank to the vacuum producer. Each tank shall be equipped with a gate and swing type check valve at the bottom drain. With

negative pressure in the tank, the check valve shall remain closed to maintain vacuum. When negative pressure ceases, either by vacuum producer shutdown or by closure of the outgoing air solenoid control by the liquid level sensor, the check valve shall open and the tank shall undergo gravity drain.

2.10.1.7 Piping

[AM#2]Vacuum pipes shall be of copper type L piping material, shall have a smooth internal surface, and shall not collapse when installed in an VAC system evacuated to 12 inch Hg gauge. Piping shall be cut square, with burrs removed, and installed with minimum obstruction to airflow. Fittings, supports, and joint assembly shall comply with NAPHCC Plumbing Code. The assembled piping system shall be suitable for [__12"_] inch Hg vacuum service, actual operating pressure is 9" Hg vacuum near the turbines and 7-8" Hg vacuum from last service connection to first service connection on the piping. Fittings shall be the long-radius type for turns and the wye type for branches. Vacuum piping shall slope not less than 0.12 inch/foot to the separator tanks. The most distant end of each trunk line from the separators shall terminate with a vacuum relief valve. Couplings, unions, and other disconnecting couplings shall be readily accessible at all times. Discharge piping from the vacuum producers shall [AM#2] be galvanized steel schedule 40 pipe.

2.10.1.8 Vacuum Relief Valve

The vacuum relief valve shall be mechanically operated. The valve shall operate automatically at [__10___] inch Hg vacuum and shall be adjustable between [_5_] and [_15__] inch Hg vacuum. The vacuum relief valve connector shall be 0.5 inch NPT. The valve shall be equipped with a silencer to attenuate air noise to 85 dB.

2.10.1.9 Spare Parts

A turbo-exhauster bearing and coupling kit shall be furnished with the delivered system and shall consist of one set of exhauster bearings and one complete motor/exhauster flexible coupling, all of the same size and design as those supplied with the turbo-exhauster. The kit shall also include complete installation instructions for repair kit items.

2.11 DOMESTIC WATER SERVICE METER

Cold water meter shall be of the positive displacement type conforming to AWWA C700. Meter register may be round or straight reading type, indicating gallons. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories. See Automated Meter Reading Specification 13815.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. There shall be no plastic piping used on the interior plumbing on this project. All above ceiling areas are air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible

in accordance with NFPA 90A. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A gate valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to

transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific excepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

[AM#1]3.1.2 Dental Compressed Air and Vacuum Piping (Non-Oil Free)

Dental compressed air, DCA, and vacuum piping, VAC, shall be cleaned, tested, and installed as specified in NFPA 99. Piping shall be connected near the top of the receiver. Vacuum pump exhaust pipe shall be extended to the roof of the building and its end turned down and screened against insects. A dry nitrogen gas or other approved inert gas purge shall be provided to prevent oxide formation inside the copper tubing when silver brazing joints. Compressed air and vacuum system alarms shall be provided and located in the Dental Treatment area as shown in the mechanical plan view. The alarm panel shall be stainless steel faceplate with a visual red light for compressed air main system header pressure lower than 90 psig and a green light to indicate that the unit has power to its automatic control system and motor starters. Lights shall be labeled. The Vacuum system shall have an identical stainless faceplate with a red light that shall light if vaccuum does not exceed 9" Hg in the main header, and a green light to indicate that the unit has power to its automatic control system and motor starters. The alarm set points shall be adjustable in the dental equipment [AM#2]room. DCA Joints shall be brazed, except at valves or equipment [AM#2]requiring threaded pipe connections. VAC system piping shall be [AM#2]soldered. Pipe threads on shutoff valves shall be installed with [AM#2]Teflon tape. The medical compressed air piping and vacuum system piping shall be suitable for 125 psig working pressure. Vacuum at 8" inches of mercury shall be provided dental chairs. Pipelines shall be readily identified by appropriate system labeling at intervals of not more than 20 feet and with at least one such identification in each room. Antivibration couplings shall be installed between the vacuum pump and the

pipeline and between the vacuum pump and the exhaust pipe. Initial startup [AM#2] of the oil-free compressed air system and the vacuum system shall be under the supervision of system's manufacturer.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.3.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.3.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.5 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections. Connections shall be made with a multiflame torch.

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA Tube Handbook with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA Tube Handbook.

c. Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to ensure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC Plumbing Code using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

[AM#1] 3.1.3.6 Plastic Pipe

Plastic PVC piping is only used on the interior room stand pipes and traps for the film developers in the xray rooms prior to the piping dropping below the floor into the air plenum where it shall then be cast iron. Plastic piping shall not be used on the plumbing of this building as all above ceiling and underfloor areas of the 2nd and 3rd floors are air plenums. The first floor ceiling space is also an air plenum. Neither is plastic piping is not allowed under the foundation of the building.

3.1.3.7 Other Joint Methods

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Corrosion Protection for Buried Pipe and Fittings

3.1.5.1 Cast Iron and Ductile Iron

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA C105. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.5.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for cast-iron soil pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves for membrane waterproof floors shall be steel pipe, cast-iron pipe, or plastic pipe. Membrane clamping devices shall be provided on pipe sleeves for waterproof floors. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Plastic sleeves shall not be used in nonbearing fire walls, roofs, or floor/ceilings. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07900 JOINT SEALING. Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above. The annular space between pipe and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and [concrete] [masonry] wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

3.1.6.2 Flashing Requirements

Pipes passing through roof or floor waterproofing membrane shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.6.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items

penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07900 JOINT SEALING.

3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.8.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for pipe 2 inches and larger and for smaller pipe sizes when the insulation is suspected of being visibly compressed, or distorted at or near the shield/insulation interface. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 40 shields used on insulated pipe shall have high density inserts with a density of 8 pcf or greater.

l. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less that 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

m. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

n. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle,

welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

3.1.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be bronze.

3.2 WATER HEATERS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Installation of Gas- Fired Water Heater

Installation shall conform to NFPA 54 for gas fired and NFPA 31 for oil fired. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 24 inches just before turning downward or directly horizontal into the water heater's inlet and

outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

3.2.3 Phenolic Resin Application Process

The phenolic resin coating shall be applied at either the coil or coating manufacturer's factory. The hot water coil shall be chemically cleaned to remove any scale if present and to etch the metal surface. The exposed exterior surface of the coil shall be abrasively cleaned to white metal blast in accordance with SSPC SP 5/NACE 1. The exterior surface shall be coated with the three-component coating system in the following sequence and manner. For immediate and final cure times and temperature, the recommendations of the coating manufacturer shall be followed.

a. Wash Primer. One coat of wash primer shall be applied by flooding.

b. Pigmented Base Coat. Pigmented baking phenolic coating shall be applied in several coats by immersion or flooding to a dry film thickness of 4 to 6 mils.

c. Clear Top Coat. Clear non-pigmented baking phenolic top coat shall be applied in several coats by immersion or flooding. The final coat may be applied by spraying. The dry film thickness of the total coating system shall be between 5 and 7 mils.

3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges. Provide vacuum breakers on cold water connection to each water heater.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting

compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor.Bumpers for water closet seats shall be installed on the flushometer spud.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with CABO A117.1.

3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.5.2 Support for Cellular-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the cellular wall using through bolts and a back-up plate.

3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.5.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with NAPHCC Plumbing Code at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.7 Access Panels

Access panels shall be provided for concealed valves, water hammer arrestors and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METAL.

3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 10 percent of the lowest equipment rpm.

3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer.

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTING, GENERAL.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance [AM#1]with NAPHCC Plumbing Code and this specification.

a. Drainage and Vent Systems Tests.

b. Building Sewers Tests.

c. Water Supply System

[AM#1]d. Dental System VAC and DCA Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically

designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

[AM#2]

A Customer Service Inspection Certificate shall be issued in accordance with the following additional inspection and verification:

The Rules and Regulations for Public Water Systems (TNRCC publication number RG-193) require a customer service inspection certification before providing continuous water service for the following conditions:

New construction involving plumbing or mechanical systems; or
Material improvement, correction or addition to plumbing; or mechanical systems.

The Customer Service Inspection certifies that for work done under this contract:

A. No direct connection between the public drinking water supply and a potential source of contamination exists;
B. No cross-connection between the public drinking water supply and a private water system exists;
C No connection exists which would allow the return of water used for condensing, cooling industrial processes back to the public water supply;
D. No pipe or pipe fitting which contains more than 8.0 percent lead exists in private water distribution facilities installed on or after July 1, 1988; or
E. No solder or flux which contains more than 0.2 percent lead exists in private water distribution facilities installed on or after July 1, 1988.

Customer Service Inspections must be performed by personnel meeting the requirements described in the Rules and Regulations for Public Water Systems. Examples are individuals licensed by the Plumbing Examiners Board (Licensed Plumbers or Plumbing Inspectors) or Certified Waterworks Operators and members of other water-related professional groups who hold an endorsement granted by the commission or its designated agent (have been to the 10 hour training approved by TNRCC). Original copies of the Customer Service Inspection Certification shall be provided to the Contracting Officers Representative prior to final inspection and acceptance.

Sample form:

Customer Service Inspection Certification

Fort Hood Texas Public Water System
Location of Service: _____

I, _____, upon inspection of the water distribution facilities connected to the aforementioned Fort Hood water supply do hereby certify that, to the best of my knowledge:

Compliance Non-compliance

1. No direct connection between the public drinking water supply and a potential source of contamination exists. Potential sources of contamination are isolated from the public water system by an air gap or an appropriate backflow prevention assembly in accordance with TNRCC regulations. _____ _____

2. No cross-connection between the public drinking water supply and a private water system exists. Where an actual air gap is not maintained between the public water supply and a private water supply, an approved reduced pressure-zone backflow prevention assembly is properly installed and a service agreement exists for annual inspection and testing by a certified backflow prevention device tester_____ _____

3. No connection exists which would allow the return of water used for condensing, cooling or industrial processes back to the public water supply. _____ _____

4. No pipe or pipe fitting which contains more than 8.0 percent lead exists in Private water distribution facilities installed on or after July 1, 1988. _____ _____

5. No solder or flux which contains more than 0.2 percent lead exists in private Water distribution facilities installed on or after July 1, 1988. _____ _____

Water service shall not be provided or restored to the private water distribution facilities until the above conditions are determined to be in compliance.

I further certify that the following materials were used in the installation of the private water distribution facilities:

Service Lines	Lead_____	Copper_____	PVC_____	Other_____
Solder	Lead_____	Lead Free_____	Solvent Weld_____	Other_____

I recognize that this document shall become a permanent record of the aforementioned Public Water System and that I am legally responsible for the validity of the information I have provided.

_____ _____ _____
Signature of Inspector Registration Number Date

_____ _____
Title Type of Registration

[AM#1]3.9.1.2 Dental Compressed Air Piping (Oil-Free)

Dental Compressed air piping system shall be cleaned, pressure tested, cross-connection tested, purged, and final tested in accordance with NFPA 99. Piping systems shall be filled with gaseous nitrogen to 150 psig and pressure maintained for a minimum of 2 hours without requiring additional nitrogen. In lieu of gaseous nitrogen, oil-free dry air specially filtered may be utilized. At point of introduction into piping system, the oil-free dry air shall be injected through a three-stage filtering assembly consisting of a 5 micrometer prefilter, and a two-stage combination microcoalescer and filtration unit utilizing activated charcoal granules for capture of oil vapors. The filtering assembly shall be rated to remove 99.99998 percent of any oil, water, and solid particles 0.03 micrometers or larger present in the air.

3.9.2 Oral Evacuation Vacuum System for Dental Operatories

Tests shall be performed by the Contractor under the supervision of a competent engineer who has had at least 5 years experience installing and testing central high-volume evacuation systems for dental operatories. The Contractor shall prepare and submit a test schedule and a testing procedure to the Contracting Officer for approval. The Contractor shall furnish test materials, piping or tubing, equipment, and instruments. The Contractor shall calibrate test instruments at a qualified independent laboratory. Test shall be witnessed by the Contracting Officer.

3.9.2.1 Testing of Piping for Leaks

The completed piping system between turbine suction connection and operating separator connections shall be exhausted down to a vacuum of not less than 11 inches of mercury after initial drying out of pipeline. The pressure shall not increase by more than 0.4 inches of mercury in 1 hour. In the event vacuum does not hold, leaks shall be located and repaired, and testing redone until the required vacuum holds.

3.9.2.2 Air Flow and Vacuum Tests

Air flow and vacuum tests shall be performed to confirm that the system can meet vacuum and air flow requirements at aspirator tips and that vacuum turbines can produce the required capacity. Testing shall be performed after equipment is properly installed, and piping cleaned and proved tight. A nominal 3/8 inch internal diameter tube of 5 feet minimum length shall be installed temporarily at each dental operatory water-air separator inlet connection. In the event water-air separator is not installed or available for connection, an 5/16 inch internal diameter tube of 5 feet minimum length shall be connected temporarily to each water-air separator discharge connection point. Tubes shall have smooth internal bore and shall be suitable for maximum system vacuum. Required fittings and valves for connection of air flow gauges, vacuum gauges, and air flow adjustment and shut off devices shall be provided with tubes. Each tube shall handle a minimum of [_15_] standard cfm of air flow and a suitable vacuum gauge shall be installed temporarily on the suction of each vacuum turbine. Tests shall start after the system has been operated and dried out. Tests shall be conducted for a period of not less than 2 hours. Testing shall be done with one turbine operating and then with both turbines operating. When one turbine operates, testing shall be done at [_5__] tubes and the other tubes shall be closed or blanked. On testing with two turbines, testing shall be

done at [_10__] tubes and other tubes shall be closed or blanked.

3.9.2.3 Recorded Test Data

Air flow, vacuum readings of each tube, and vacuum of the turbine suctions shall be recorded in 10-minute intervals. Three copies of recorded test data shall be furnished to the Contracting Officer.

3.9.2.4 General Operating Tests

General operating tests shall be conducted during or after air flow and vacuum tests to ensure that the turbines start up and cycle properly. In addition, each operatory tube shall be tested with at least 1 quart of water to assure proper separation after the water is pulled into the evacuation system.

[AM#1]3.9.3 DEFECTIVE WORK

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new material. Caulking of screwed joints or holes will not be acceptable.

3.9.4 System Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. In general, sufficient water shall be used to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

3.9.5 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.9.6 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.10 PLUMBING FIXTURE SCHEDULE

P-1 WATER CLOSET:

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, wall mounted. [AM#3]_____.

Gasket shall be [AM#3] neoprene type.

Seat - IAPMO Z124.5, Type A, white plastic, elongated, open front.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 1.6 gallons per flush.

P-2 WATER CLOSET HANDICAPPED:

Height of top rim of bowl shall be in accordance with CABO A117.1; other features are the same as P-1 [AM#3] except flush valve shall be automatic flushing. Stack carrier required for location and mounting height.

P-3 URINAL:

Wall hanging, with integral trap and extended shields, ASME A112.19.2M siphon jet. Top supply connection, back outlet.

Flushometer Valve - Similar to Flushometer Valve for P-1. The maximum water use shall be 1 gallon per flush.

[AM#1] (removed waterless paragraph)
P-5 LAVATORY:

Manufacturer's standard sink depth, vitreous china ASME A112.19.2M [AM#1] countertop, oval 20 1/4" x 17 1/4".

[AM#1]Faucet - Faucets shall be single lever control, mixing type. Faucets shall have replaceable seats and washers. Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing pressure of 80 psi.

Handles - Lever type. Cast, formed, or drop forged copper alloy.

Drain - Strainer shall be copper alloy or stainless steel.Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece.

P-6 WHEELCHAIR LAVATORY:

Vitreous china, ASME A112.19.2M, wheelchair lavatory with wrist or elbow

controls 20 inches wide x 27 inches deep with gooseneck spout. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water pressure of 80 psi.

Drain - Strainer shall be copper alloy or stainless steel.

[AM#1]P-7 DENTAL PROCESS SINK:

[AM#1]Countertop self rimming with holes for faucet and spout double bowl 42 x 21 inches stainless steel ASME A112.19.3M.

Faucet and Spout - Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water pressure of 80 psi.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be stainless steel. There are chemicals that will attack copper these areas where a P-7 is located.

P-8 SERVICE SINK:

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.19.3M trap standard support 24 inches wide x 20 inches deep, sink bowl is 12 3/4" depth with splashback 12 inches high wall hanger.

Faucet and Spout - Cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be lever type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

Trap - Cast iron, minimum 3 inch diameter with floor flange to support fixture..

P-9 Break Area Sink:

[AM#1]Stainless steel self rimming, 25" x 22" x 8"

[AM#1]Faucet and Spout - Single lever mixing type faucet, chrome finish. Cast or wrought copper alloy, without top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads. Combination faucets with two valves and spouts shall be provided.

Handles - Cast or wrought copper alloy. Lever type.

P-10 LABORATORY SINK:

[AM#1]P-10 is integral with the dental casework sink and is provided by the dental casework vendor outside of this construction contract. Stub up the plumbing with valves as detailed on the plumbing drawings. The connection work beyond the valves an loop vent to the faucets and sink are work of casework vendor. Thickness of sinks shall be manufacturer's standard. Drain and trap shall be stainless steel.

[AM#1]P-15 Electric Water Cooler:

Electric Water Cooler shall: be self contained, conform to ARI 1010, use one of the fluorocarbon gases conforming to ARI 700 and ASHRAE 34 which has an Ozone Depletion Potential of less than or equal to 0.05, have a capacity to deliver 8 gph of water at 50 degrees F with an inlet water temperature of 80 degrees F while residing in a room environment of 90 degrees F, and have self-closing valves. Self-closing valves shall have automatic stream regulators, have a flow control capability, have a push button actuation or have a cross-shaped index metal turn handle without a hood. Exposed surfaces of stainless steel shall have No. 4 general polish finish. Spouts shall provide a flow of water at least 4 inches high so as to allow the insertion of a cup or glass under the flow of water.

Surface Wall-Mounted - Surface wall-mounted units shall be 13-1/4 inches wide, 13 inches deep, and have a back height of 6 to 8 inches. The bowl shall be made of stainless steel. The unit shall have concealed fasteners and be for interior installation.

Handicapped - Handicapped unit is same as regular unit except mounting height changes, see architectural elevations for mounting heights.

3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.12 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS
[AM#1]For item 4,6,7,8,10,16,17 & 18 Service "A" has been deleted.
[AM#2] Deleted Service "F"

		SERVICE				
Item #	Pipe and Fitting Materials	A	B	C	D	E
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	X
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888		X	X	X	
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X	
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47, ASTM A 47M		X		X	X
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47, ASTM A 47M for use with Item 5		X		X	X
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5		X		X	X
8	Wrought copper grooved joint pressure pressure fittings for non-ferrous pipe ASTM B 75 C12200, ASTM B 152, ASTM B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5		X			
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X
10	Steel pipe, seamless galvanized, ASTM A 53, Type S, Grade B				X	X
11	Seamless red brass pipe, ASTM B 43		X	X		

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS
[AM#1]For item 4,6,7,8,10,16,17 & 18 Service "A" has been deleted.
[AM#2] Deleted Service "F"

		SERVICE				
Item #	Pipe and Fitting Materials	A	B	C	D	E
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X
14	Seamless copper pipe, ASTM B 42			X		
15	Cast bronze threaded fittings, ASME B16.15				X	X
16	Copper drainage tube, (DWV), ASTM B 306		X	X*	X	X
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29		X	X	X	X
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23		X	X	X	X

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
[AM#2] DELETED SERVICE F
* - Hard Temper

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS
[AM#1] FOR ITEMS 1-7 & 9-12 SERVICE "C" HAS BEEN DELETED.
[AM#2] ADDED SERVICE D FOR DENTAL ORAL VACUUM

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a b. Same as "a" but not galvanized for use with Item 4b	X	X		
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47, ASTM A 47M, non-ferrous pipe, ASTM A 536 and ASTM A 47, ASTM A 47M	X	X		
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47, ASTM A 47M for use with Item 2	X	X		
4	Steel pipe: a. Seamless, galvanized, ASTM A 53, Type S, Grade B b. Seamless, black, ASTM A 53, Type S, Grade B	X	X		
5	Seamless red brass pipe, ASTM B 43	X	X		
6	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		
7	Seamless copper pipe, ASTM B 42	X	X	X	
[AM#2] 8	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X***	X**
9	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		
[AM#2} 10	Wrought copper and bronze solder-joint	X	X		X

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS
[AM#1] FOR ITEMS 1-7 & 9-12 SERVICE "C" HAS BEEN DELETED.
[AM#2] ADDED SERVICE D FOR DENTAL ORAL VACUUM

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
	pressure fittings, ASME B16.22 for use with Items 5 and 7				
[AM#2] 11	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 8 and 9	X	X	X	X
12	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 2	X	X		
32	Steel pipeline flanges, MSS SP-44	X	X		
33	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X		
34	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X		
35	Malleable-iron threaded pipe unions ASME B16.39	X	X		
36	Nipples, pipe threaded ASTM A 733	X	X		

A - Cold Water Aboveground & Belowground
B - Hot Water 180 degrees F Maximum Aboveground
C - Dental Compressed Air Medical Gas, Air Oil-Free
[AM#2] D - DENTAL ORAL VACUUM

Indicated types are minimum wall thicknesses.
** - Type L - Hard
*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors

SECTION 15895

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM
02/94
AMENDMENT NO. 0002
AMENDMENT NO. 0003

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.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 350	(1986) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1989) Central-Station Air-Handling Units
ARI 440	(1997) Room Fan-Coil and Unit Ventilator
ARI 445	(1987; R 1993) Room Air-Induction Units
ARI 880	(1994) Air Terminals
ARI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

ACCA Manual 4	(1990) Installation Techniques for Perimeter Heating & Cooling; 11th Edition

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1985) Laboratory Methods of Testing Fans for Rating
AMCA 300	(1996) Reverberant Room Method for Sound Testing of Fans

AMERICAN BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA Std 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
AFBMA Std 11	(1990) Load Ratings and Fatigue Life for

Roller Bearings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.32	(1990; R 1996) Precision Methods for the Determination of Sound Power Levels of Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990; R 1995) Ferritic Malleable Iron Castings
ASTM A 47M	(1990; R 1996) Ferritic Malleable Iron Castings (Metric)
ASTM A 53	(1998) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1997a) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181/A 181M	(1995b) Carbon Steel, Forgings for General-Purpose Piping
ASTM A 183	(1983; R 1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(1998)(Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234/A 234M	(1997) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 733	(1993) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 924/A 924M	(1997a) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1997) Seamless Copper Tube

ASTM B 75M	(1997) Seamless Copper Tube (Metric)
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM B 117	(1997) Operating Salt Spray (FOG) Apparatus
ASTM B 650	(1995) Electrodeposited Engineering Chromium Coatings on Ferrous Substrates
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications for Copper and Copper Alloy Tube
ASTM C 916	(1985; R 1996) Adhesives for Duct Thermal Insulation
ASTM C 1071	(1998) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 520	(1984; R 1995) Zinc Dust Pigment
ASTM D 1384	(1997a) Corrosion Test for Engine Coolants in Glassware
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1785	(1996b) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(1998a) Rubber Products in Automotive Applications
ASTM D 2466	(1997) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM E 84	(1998el) Surface Burning Characteristics of Building Materials
ASTM E 437	(1992) Industrial Wire Cloth and Screens (Square Opening Series)
ASTM F 872	(1984; R 1990) Filter Units, Air-Conditioning: Viscous-Impingement

	Type, Cleanable
ASTM F 1199	(1988; R 1998) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988; R 1998) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
ASHRAE 52.1	(1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE 68	(1986) Laboratory Method of Testing In-Duct Sound Power Measurement Procedures for Fans
ASHRAE 70	(1991) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 84	(1991) Method of Testing Air-to-Air Heat Exchangers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for

	Flared Copper Tubes
ASME B16.39	(1986; R 1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1998) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1419	(Rev D) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types, Replaceable)

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(1998; 7th Ed.) EJMA Standards

INSTITUTE OF ENVIRONMENTAL SCIENCES (IES)

IES RP-CC-001.3	(1993) HEPA and ULPA Filters

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
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-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	(1992) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3; Rev 4) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 90A	(1996) Installation of Air Conditioning and Ventilating Systems
NFPA 96	(1998) Ventilation Control and Fire Protection of Commercial Cooking Equipment

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)

NAIMA AH115	(1993) Fibrous Glass Duct Construction Standards

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Industry Practice	(1975) Accepted Industry Practice for Industrial Duct Construction
SMACNA Install Fire Damp HVAC	(1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA HVAC Duct Const Stds	(1995; Addenda Nov 1997) HVAC Duct Construction Standards - Metal and Flexible
SMACNA Leakage Test Mnl	(1985) HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES (UL)

UL 94	(1996; Rev thru Jul 1998) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 181	(1996; Rev Dec 1998) Factory-Made Air Ducts and Air Connectors
UL 214	(1997) Tests for Flame-Propagation of Fabrics and Films
UL 555	(1999) Fire Dampers

UL 586	(1996) High-Efficiency, Particulate, Air Filter Units
UL 705	(1994; Rev thru Mar 1996) Power Ventilators
UL 723	(1996) Test for Surface Burning Characteristics of Building Materials
UL 900	(1994; Rev thru Apr 1997) Test Performance of Air Filter Units
UL 1995	(1995; Rev thru Jul 1998) Heating and Cooling Equipment
UL Bld Mat Dir	(1998) Building Materials Directory
UL Elec Const Dir	(1998) Electrical Construction Equipment Directory
UL Fire Resist Dir	(1998) Fire Resistance Directory (2 Vol.)

1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Components and Equipment Data; FIO.

Manufacturer's catalog data shall be included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

a. Piping Components

b. Ductwork Components

c. Air Systems Equipment

d. Air Handling Units

f. Terminal Units

SD-04 Drawings

Air Supply, Distribution, Ventilation, and Exhaust Equipment; FIO.

Drawings shall consist of equipment layout including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

SD-06 Instructions

Test Procedures; FIO.

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

Welding Procedures; FIO.

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

System Diagrams; GA.

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

SD-07 Schedules

Test Schedules; FIO.

Proposed test schedules for hydrostatic test of piping, ductwork leak test, and performance tests, at least 2 weeks prior to the start of related testing.

Field Training Schedule; FIO.

Proposed schedule for field training, at least 2 weeks prior to the start of related training.

SD-08 Statements

Similar Services; FIO.

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

Welding Qualification; FIO.

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

SD-09 Reports

Test Reports; FIO.

Test reports for the piping hydrostatic test, ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

SD-13 Certificates

Bolts; FIO.

Written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, and the number of each type of bolt to be furnished.

SD-19 Operation and Maintenance Manuals

Air Supply, Distribution, Ventilation, and Exhaust Manuals; GA.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is

offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

Equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified. Catwalks, operating platforms, ladders, and guardrails shall be provided where shown and shall be constructed according to Section 05500 MISCELLANEOUS METAL.

2.5 PIPING COMPONENTS

Piping components shall be in accordance with section 15569 WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH and section 15650 CENTRAL REFRIGERATED AIR CONDITIONING SYSTEM.

2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 16415 ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 1 hp and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized for motors rated 10 hp or less. Adjustable frequency drives shall be used for larger motors.

2.7 CONTROLS

Controls shall be provided as specified in Section 15972 DIRECT DIGITAL CONTROL SYSTEMS.

2.8 DUCTWORK COMPONENTS

2.8.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA HVAC Duct Const Stds unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 1/2, 1, and 2 inch w.g. ductwork shall meet the requirements of Seal Class C. Class 3 through 10 inch shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA HVAC Duct Const Stds. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

2.8.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

2.8.1.2 Metallic Flexible Duct

Metallic type duct shall be single-ply galvanized steel , self supporting to 8 foot spans. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 1/2 duct diameter. Duct shall conform to UL 181and shall be rated for positive or negative working pressure of 15 inches water gauge at 350 degrees F when duct is aluminum, and 650 degrees F when duct is galvanized steel or stainless steel.

2.8.1.3 Insulated Nonmetallic Flexible Duct Runouts

Flexible duct runouts shall be used only where indicated. Runout length shall be as shown on the drawings, but shall in no case exceed 10 feet. Runouts shall be preinsulated, factory fabricated, and shall comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be

a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as runouts. The insulated material and vapor barrier shall conform to the requirements of Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation material surface shall not be exposed to the air stream.

2.8.1.4 General Service Duct Connectors

A flexible duct connector approximately 6 inches in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.8.2 Fibrous Glass Ductwork

Fibrous glass ductwork shall not be used.

2.8.3 Ductwork Accessories

2.8.3.1 Duct Access Doors

Access doors shall be provided in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA HVAC Duct Const Stds
. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 15 x 18 inches, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 24 x 24 inches or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

2.8.3.2 Fire Dampers

Fire dampers shall be 1-1/2 hour fire rated unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. The Contractor shall perform the fire damper test as outlined in NFPA 90A. A pressure relief damper shall be provided upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then this pressure relief damper shall be factory insulated. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it will be subjected. Fire dampers shall be approved for the specific application, and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies shall be constructed in conformance with UL Fire Resist Dir. Fire dampers shall be

curtain type with damper blades out of the air stream. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.8.3.3 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 3/16 inch rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 8 inches. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 12 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

2.8.3.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at duct mounted supply outlets, at takeoff or extension collars to supply outlets, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections shall be used in lieu of deflectors or extractors for branch connections. All air deflectors, except those installed in 90 degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein. Fixed air deflectors, also called turning vanes, shall be provided in 90 degree elbows.

2.8.4 Duct Sleeves, Framed Prepared Openings, Closure Collars

2.8.4.1 Duct Sleeves

Duct sleeves shall be provided for round ducts 15 inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15 inches in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20 gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53, Schedule 20 shall be used. Sleeve shall provide 1 inch clearance between the duct and the sleeve or 1 inch clearance between the insulation and the sleeve for insulated ducts.

2.8.4.2 Framed Prepared Openings

Openings shall have 1 inch clearance between the duct and the opening or 1 inch clearance between the insulation and the opening for insulated ducts.

2.8.4.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15 inches in diameter or less shall be fabricated from 20 gauge galvanized steel. Collars for round ducts larger than 15 inches and square, and rectangular ducts shall be fabricated from 18 gaugegalvanized steel. Collars shall be installed with fasteners on maximum 6 inch centers, except that not less than 4 fasteners shall be used.

2.8.5 Sound Attenuation Equipment

a. Sound Attenuators

Sound attenuators shall be provided as shown and scheduled on the drawings for each fan system. The sound attenuators shall be factory fabricated and shall be tested by an independent laboratory for sound and performance characteristics. Net sound reduction shall be as indicated. Maximum permissible pressure drop shall be as scheduled. Attenuators shall be constructed to be airtight when operating under an internal static pressure of 10 inch water gauge. Air-side surface shall be capable of withstanding air velocity of 10,000 fpm. The Contractor shall certify that the sound reduction values specified will be obtained after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Sound absorbing material shall conform to ASTM C 1071, Type I or II. Sound absorbing material shall meet the fire hazard rating requirements for insulation specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. A duct transition section shall be provided for connection to ductwork.

b. Acoustical Duct Liner:

Acoustical duct lining shall be fibrous glass designed exclusively for lining ductwork and shall conform to the requirements of ASTM C 1071, Type I and II. Liner composition may be uniform density, graduated density, or dual density, as standard with the manufacturer. Lining shall be coated, not less than 1 inch thick. Where acoustical duct liner is used, liner or combination of liner and insulation applied to the exterior of the ductwork shall be the thermal equivalent of the insulation specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Duct sizes shown shall be increased to compensate for the thickness of the lining used. In lieu of sheet metal duct with field-applied acoustical lining, acoustically equivalent lengths of factory fabricated double-walled internally insulated duct with perforated liner may be provided. Net insertion loss value, static pressure drop, and air flow velocity capacity data shall be certified by a nationally recognized independent acoustical laboratory.

2.8.6 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified according to ASHRAE 70. Inlets and outlets shall be sound rated and certified according to ASHRAE 70. Sound power level shall be as indicated. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers. Linear slot diffusers shall be provided with round or elliptical balancing dampers [AM#1] located in the plenum boot inlet. Where the inlet and outlet openings are located less than 7 feet above the floor, they shall be protected by a grille or screen according to NFPA 90A.

2.8.6.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL Elec Const Dir for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers. Diffusers utilizing perforated plates shall not be used except where indicated.

2.8.6.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar

in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 6 inches below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 6 inches above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

2.8.7 Louvers

Louvers for installation in exterior walls which are associated with the air supply and distribution system shall be as specified in Section 07600 SHEET METALWORK, GENERAL.

2.8.8 Roof Top Relief Air Penthouses

Relief air penthouses shall be fabricated from extruded aluminum shapes. Finish shall be anodized bronze. Where structural members are hidden from view, mill finish aluminum is acceptable. Louver blades shall be accurately fitted and secured to frames. Edges of louver blades shall be shaped for rigidity and baffled to exclude driving rain. Louver blades shall be fixed and drainable.Relief penthouses shall be provided with bird screen. Weighted, adjustable, horizontal barometric backdrafts shall be provided across the full dimension of the opening. The penthouse sides or roof shall be designed to allow easy removal for access to barometric damper adjustment. Penthouse size and capacity shall be as indicated. Barometric dampers shall start to open at 0.03 inches W.C. and shall be fully open at 0.05 inches W.C. Penthouses shall be provided with a factory fabricated roof curb. Relief air penthouse louvers shall be tested by an independant testing laboratory for water penetration in accordance with Air Movement and Control Association (AMCA) Standard 500. Water penetration shall not exceed 0.01 ounces per square foot at a velocity of 1250 feet per minute when tested for 15 minutes per AMCA Standard 500. Corner connections shall be gasketed for watertight construction.

2.8.9 Bird Screens and Frames

Bird screens shall conform to ASTM E 437, Type I, Class 1, 2 by 2 mesh, 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire. Frames shall be removable type or stainless steel or extruded aluminum.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 120 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable

metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

2.9.1.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan wheels over 36 inches in diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 36 inches or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by AFBMA Std 9 and AFBMA Std 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have dripproof enclosures. Motor starters shall be indicated type with indicated enclosure.

2.9.1.2 Panel Type Power Wall Ventilators

Fans shall be propeller type, assembled on a reinforced metal panel with venturi opening spun into panel. Fans with wheels less than 24 inches diameter shall be direct or V-belt driven and fans with wheels 24 inches diameter and larger shall be V-belt drive type. Fans shall be furnished with wall mounting collar. Lubricated bearings shall be provided. Fans shall be fitted with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Motor enclosure shall be dripproof type. Motor operated backdraft dampers shall be provided where indicated.

2.9.1.3 Centrifugal Type Power Roof Ventilators

Fans shall be direct or V-belt driven with backward inclined, non-overloading wheel. Motor compartment housing shall be hinged or removable and weatherproof, constructed of heavy gauge aluminum. Fans shall be provided with birdscreen, disconnect switch, gravity or motorized dampers, as indicated, roof curb, and extended base. Motors enclosure shall be dripproof type.

2.9.2 Coils

Coils shall be fin-and-tube type constructed of seamless copper tubes and copper fins mechanically bonded or soldered to the tubes. Copper tube wall thickness shall be a minimum of 0.024 inches. Copper fins shall be 0.0045 inch minimum thickness. Casing and tube support sheets shall be not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Each coil shall be tested at the factory under water at not less than 400 psi air pressure and shall be suitable for 200 psi working pressure. Coils shall be mounted for counterflow service. Coils shall be rated and certified according to ARI 410.

2.9.2.1 Water Coils

Water coils shall be installed with a pitch of not less than 1/8 inch per foot of the tube length toward the drain end. Headers shall be constructed of cast iron, welded steel or copper. Each coil shall be provided with a plugged vent and drain connection extending through the unit casing.

2.9.3 Air Filters

Air filters shall be listed according to requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method shall be as listed under the Label Service and shall meet the requirements of UL 586.

2.9.3.1 Extended Surface Pleated Panel Filters

Filters shall be 2 inch depth, sectional, disposable type of the size indicated and shall have an average efficiency of 25 to 30 percent when tested according to ASHRAE 52.1. Initial resistance at 500 feet per minute shall not exceed 0.36 inches water gauge. Filters shall be UL Class 2. Media shall be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media shall be attached to a moisture resistant fiberboard frame. All four edges of the filter media shall be bonded to the inside of the frame to prevent air bypass and increase rigidity.

2.9.3.2 Filter Gauges

Filter gauges shall be dial type, diaphragm actuated draft and shall be provided for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 3-7/8 inches in diameter, shall have white dials with black figures, and graduations and shall have a minimum range of 1 inch beyond the specified final resistance for the filter bank on which each gauge is applied. Each gauge shall incorporate a screw operated zero adjustment and shall be furnished complete with two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter [aluminum tubing, and all hardware and accessories for gauge mounting.

2.10 AIR HANDLING UNITS

2.10.1 Field-Fabricated Air Handling Units

Built-up units shall not be used.

2.10.2 Factory-Fabricated Air Handling Units

Units shall be as indicated. Units shall include fans, coils, airtight insulated casing, filter sections, moisture eiliminator sections where indicated, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, mixing box, vibration-isolators, and appurtenances required for specified operation. Vibration isolators shall be as indicated. Each air handling unit shall have physical dimensions suitable to fit space allotted to the unit and shall have the capacity indicated. Air handling unit shall have published ratings based on tests performed according to ARI 430.

2.10.2.1 Casings

Casing sections shall be 2 inch double wall type constructed of a minimum 18 gauge galvanized steel, or 18 gauge steel outer casing protected with a corrosion resistant paint finish according to paragraph FACTORY PAINTING. Inner casing of double-wall units shall be minimum 20 gauge solid galvanized steel. Casing shall be designed and constructed with an integral structural steel frame such that exterior panels are non-load bearing. Exterior panels shall be individually removable. Removal shall not affect the structural integrity of the unit. Casings shall be provided with inspection doors, access sections, and access doors as indicated. Inspection and access doors shall be insulated, fully gasketed, double-wall type, of a minimum 18 gauge outer and 20 gauge inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 12 inches wide by 12 inches high. Access doors shall be minimum 24 inches wide and shall be the full height of the unit casing or a minimum of 6 ft., whichever is less. Access Sections shall be according to paragraph AIR HANDLING UNITS. Drain pan shall be double-bottom type constructed of 16 gauge stainless steel, pitched to the drain connection. Drain pans shall be constructed water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Intermediate drain pans or condensate collection channels and downspouts shall be provided, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Each casing section handling conditioned air shall be insulated with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Factory applied fibrous glass insulation shall conform to ASTM C 1071, except that the minimum thickness and density requirements do not apply, and shall meet the requirements of NFPA 90A. Foam-type insulation is not acceptable. Foil-faced insulation shall not be an acceptable substitute for use on double-wall access doors and inspections doors and casing sections. Duct liner material, coating, and adhesive shall conform to fire-hazard requirements specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Exposed insulation edges and joints where insulation panels are butted together shall be protected with a metal nosing strip or shall be coated to conform to meet erosion resistance requirements of ASTM C 1071. A latched and hinged inspection door, shall be provided in the fan and coil sections. Additional inspection doors, access doors and access sections shall be provided where indicated.

2.10.2.2 Heating and Cooling Coils

Coils shall be provided as specified in paragraph AIR SYSTEMS EQUIPMENT,

for types indicated.

2.10.2.3 Air Filters

Air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.10.2.4 Fans

Fans shall be double-inlet, centrifugal type with each fan in a separate scroll. Fans and shafts shall be dynamically balanced prior to installation into air handling unit, then the entire fan assembly shall be statically and dynamically balanced at the factory after it has been installed in the air handling unit. Fans shall be mounted on steel shafts accurately ground and finished. Fan bearings shall be sealed against dust and dirt and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by AFBMA Std 9 and AFBMA Std 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Bearings shall be supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Bearings may not be fastened directly to the unit sheet metal casing. Fans and scrolls shall be furnished with coating indicated. Fans shall be driven by a unit-mounted or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Belt guards shall be the three sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating. Motor sheaves shall be variable pitch for 25 hp and below and fixed pitch above 25 hp as defined by ARI Guideline D. Where fixed sheaves are required, variable pitch sheaves may be used during air balance, but shall be replaced with an appropriate fixed sheave after air balance is completed. Variable pitch sheaves shall be selected to drive the fan at a speed that will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable bases. Fan motors shall have open enclosures. Motor starters shall be Variable Speed Controller type with general-purpose enclosure. Unit fan or fans shall be selected to produce the required capacity at the fan static pressure. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300 or ASHRAE 68.

2.10.2.5 Access Sections and Filter/Mixing Boxes

Access sections shall be provided where indicated and shall be furnished with access doors as shown. Access sections and filter/mixing boxes shall be constructed in a manner identical to the remainder of the unit casing and shall be equipped with access doors. Mixing boxes shall be designed to minimize air stratification and to promote thorough mixing of the air streams.

2.10.2.6 Dampers

Dampers shall be as specified in paragraph CONTROLS.

2.10.2.7 Variable Frequency Drive Unit

Unit shall be solid state with adjustable frequency and voltage,

three-phase output capable of driving standard NEMA class B induction motors. The drives shall utilize diode bridge rectifying circuitry with either variable voltage or pulse width modulation DC to AC convertors. Silicon controlled rectifiers (SCR) that are phased back shall not be used in rectifying circuitry. The drives shall be designed to be used on variable torque loads and shall be capable of providing sufficient torque to allow the motor to break away from rest upon first application of power. Unit shall be rated for 60 Hz, three-phase systems, capable of operating within voltage parameters of plus 10 to minus 15 percent of rated line voltage, and be rated for the full load amps of the maximum HP within its class. **Each unit shall be factory tested** at maximum HP, rated full load current and at an ambient of 40 degrees C for a period of not less than 24 hours. If a component fails, it shall be replaced and the test restarted for the full time period. The unit shall not add any current or voltage transients to the input AC power distribution system nor shall the controller be affected by transients from other devices on the AC power distribution system. Unit shall be protected to comply with ANSI C37.90.1, Guide for Surge Withstand Capability (SWC) Test (2,500 volts for 1 minute) and UL 508 Electrical Industrial Control Equipment.

Variable Frequency Drive Units shall have the following features:

a. Isolated power for control circuits.

b. Manually resettable motor overload protection for each phase.

c. Adjustable current limiting circuitry to provide soft motor starting. Maximum starting current shall not exceed 200 percent of motor full load current.

d. Independent accelaration and deceleration time adjustment, manually adjustable from 2 to 30 seconds. Set timers to the equipment manufacturer's recommended time in the above range.

e. Provide 4 to 20 mA current follower circuitry for interface with pressure sensor and transmitter devices.

f. Automatic frequency adjustment from 20 Hz to 60 Hz.

g. By-pass starter with circuitry to protect and isolate the variable speed controller. When the variable speed controller is in the by-pass mode the solid-state components shall be isolated from the power supply on both the line and motor side.

h. Controller efficiency at any speed shall be not less than 92 percent.

i. At 100 percent speed the input power factor shall not be less than 0.95 and shall not be less than 0.90 at any other speed.

j. Door interlocked fused safety disconnect or door interlocked circuit breaker switch shall disconnect all input power.

k. Two N.O. and two N.C. dry contacts rated 120 volts, 10 amperes, 60 Hz for remote indication of the following: controller system shutdown with auto restart, system shutdown without auto restart, and system running.

l. Limit harmonic distortion produced by the unit to no more than 3 percent voltage at 100 percent at any speed.

m. Controllers shall have circuitry to initiate an orderly shutdown after the motor stops spinning and when conditions are corrected. The controller shall not be damaged by the following electrical disturbances:

1. Incorrect phase sequence.

2. Single phasing.

3. Over voltage in excess of 10 percent.

4. Under voltage in excess of 15 percent.

5. Running over current above 150 percent (shall not automatically reset for this condition).

6. Instantaneous over current above 150 percent (shall not automatically reset for this condition).

7. Surge voltage in excess of 1,000 volts.

8. Short duration power outages of 12 cycles or less (i.e., distribution line switching, generator testing, automatic transfer switch operations).

n. Units shall have the following door-mounted accessories:

1. AC Power light.

2. Ammeter (RMS motor current).

3. Hand-Off-Automatic switch.

4. Manual speed HAND mode.

5. System protection light indicating that the system has shutdown and will not automatically restart.

6. System protection light indicating that the system has shutdown, but will restart when conditions return to normal.

7. Manual variable speed controller by-pass switch when required.

8. Diagnostic shutdown indicator lights for each shutdown condition.

2.11 TERMINAL UNITS

2.11.1 Variable Air Volume (VAV) Units

VAV terminal units shall be the type, size, and capacity shown and shall be mounted in the ceiling and shall be suitable for single or dual duct system applications. Actuators and controls shall be as specified in paragraph CONTROLS. Unit enclosures shall be constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Single or multiple discharge outlets shall be provided as required. Units with flow limiters are not acceptable. Unit air volume shall be factory preset and readily field adjustable without special tools. Reheat coils shall be provided as indicated. A flow chart shall be attached to each unit. Acoustic performance of the terminal units shall be based upon units tested according to ARI 880. Sound power level shall be as indicated. Discharge sound power shall be shown for minimum and 1-1/2 inches water gauge inlet static pressure. Acoustical lining shall be according to NFPA 90A.

2.11.1.1 Variable Volume, Single Duct

Variable volume, single duct, terminal units shall be provided with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Units shall control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Internal resistance of units shall not exceed 0.4 inch water gauge at maximum flow range. External differential pressure taps separate from the control pressure taps shall be provided for air flow measurement with a 0 to 1 inch water gauge range. Unit volume controller shall utilize an electronic inlet flow velocity sensor, electronic controller, electronic air valve actuator and 24V electric two position hydronic valve operators. Electronic VAV controller shall be matched with the electronic space temperature sensor. All VAV box electronic controllers shall be functionally interconnected to provide the capability to read all control values of any VAV terminal from any thermosensor location electronically through a hand held display unit or laptop computer. Three hand held display units shall be provided and dilivered at the commissioning walk through.

The VAV controls shall additionally include an infra-red room occupancy sensor in the conference room(s). The occupancy sensor shall provide two contact closures when occupancy is sensed. One contact shall be used to allow the VAV box to open above the minimum airflow quantity. The second contact shall be used to provide (with signal potentiometer or DDC equivalent) a CPA offset to the AHU outside air flow control which will increase the outside air to the facility.

2.11.1.2 [AM#3] DELETED

2.11.1.3 Reheat Units

a. Hot Water Coils: Hot-water coils shall be fin-and-tube type constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Headers shall be constructed of cast iron, welded steel or copper. Casing and tube support sheets shall be 16 gauge, galvanized steel, formed to provide structural strength. Tubes shall be correctly circuited for proper water velocity without excessive pressure drop and they shall be drainable where required or indicated. At the factory,

each coil shall be tested at not less than 250 psi air pressure and shall be suitable for 200 psi working pressure. Drainable coils shall be installed in the air handling units with a pitch of not less than 1/8 inch per foot of tube length toward the drain end. Coils shall conform to the provisions of ARI 410.

2.12 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123/A 123M or ASTM A 924/A 924M shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatized and coated with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors shall be submitted. Rating of failure at the scribe mark shall be not less than 6, average creepage not greater than 1/8 inch. Rating of the inscribed area shall not be less than 10, no failure. On units constructed of galvanized steel which have been welded, exterior surfaces of welds or welds that have burned through from the interior shall receive a final shop docket of zinc-rich protective paint according to ASTM D 520 Type I.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 Piping

Pipe and fitting installation shall be in accordance with section 15569 WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH and section 15650 CENTRAL REFRIGERATED AIR-CONDITIONING SYSTEM.

3.1.2 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all units. The depth of each seal shall be 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting. Air conditioner drain lines shall be insulated as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.3 Equipment and Installation

Frames and supports shall be provided for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Air handling units shall be floor mounted or ceiling hung, as indicated. The method of anchoring and fastening shall be as detailed. Floor-mounted equipment, unless otherwise indicated, shall be set on not less than 6 inch concrete pads or curbs doweled in place. Concrete foundations for circulating pumps shall be heavy enough to minimize the intensity of the vibrations transmitted to the piping and the

surrounding structure, as recommended in writing by the pump manufacturer. In lieu of a concrete pad foundation, a concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. The concrete foundation or concrete pedestal block shall be of a mass not less than three times the weight of the components to be supported. Lines connected to the pump mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.4 Access Panels

Access panels shall be provided for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METALS.

3.1.5 Flexible Connectors

Pre-insulated flexible connectors and flexible duct shall be attached to other components in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the connector or duct manufacturer and shall be provided at the intervals recommended.

3.1.6 Sleeved and Framed Openings

Space between the sleeved or framed opening and the duct or the duct insulation shall be packed as specified in Section 07840 FIRESTOPPING for fire rated penetrations. For non-fire rated penetrations, the space shall be packed as specified in Section 07900 JOINT SEALING.

3.1.7 Metal Ductwork

Installation shall be according to SMACNA HVAC Duct Const Stds unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA HVAC Duct Const Stds, unless otherwise specified. Friction beam clamps indicated in SMACNA HVAC Duct Const Stds shall not be used. Risers on high velocity ducts shall be anchored in the center of the vertical run to allow ends of riser to move due to thermal expansion. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.7.1 Light Duty Corrosive Exhaust Ductwork

Light duty corrosive exhaust ductwork shall be type 304 stainless steel.

3.1.8 Acoustical Duct Lining

Lining shall be applied in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C 916, Type I, NFPA 90A, UL 723, and ASTM E 84. Top and bottom pieces shall lap the side pieces and shall be secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA HVAC Duct Const Stds. Welded pins, cup-head pins, or adhered clips shall not distort the duct, burn through, nor mar the finish or the surface of the duct. Pins and washers shall be flush with the surfaces of the duct liner and all breaks and punctures of the duct liner coating shall be sealed with the nonflammable, fire resistant adhesive. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Duct liner may be applied to flat sheet metal prior to forming duct through the sheet metal brake. Lining at the top and bottom surfaces of the duct shall be additionally secured by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA HVAC Duct Const Stds to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, will be acceptable.

3.1.9 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Outdoor air intake ducts and plenums shall be externally insulated .

3.1.10 Duct Test Holes

Holes with closures or threaded holes with plugs shall be provided in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Extensions, complete with cap or plug, shall be provided where the ducts are insulated.

3.1.11 Power Roof Ventilator Mounting

Foamed 1/2 inch thick, closed-cell, flexible elastomer insulation shall cover width of roof curb mounting flange. Where wood nailers are used, holes shall be pre-drilled for fasteners.

3.1.12 Power Transmission Components Adjustment

V-belts and sheaves shall be tested for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.2 FIELD PAINTING AND COLOR CODE MARKING

Finish painting of items only primed at the factory, surfaces not specifically noted otherwise, and color code marking for piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.3 PIPING HYDROSTATIC TEST

After cleaning, water piping shall be hydrostatically tested at a pressure equal to 150 percent of the total system operating pressure for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Leaks shall be repaired and piping retested until test is successful. No loss of pressure will be allowed. Leaks shall be repaired by re-welding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before covering or concealing.

3.4 DUCTWORK LEAK TEST

Ductwork leak test shall be performed for the entire supply air distribution system from and including air handler fan section to and including the VAV terminal unit discharge. Test procedure shall be to operate the system to maintain a duct static pressure of 1.75 inches W.C. at the duct static pressure sensor while all VAV terminal units ar set to their normal minimum position. The standard of acceptance is no audible leak detectable by human ear and no sensible leak detectable by human hand. If disagreement exist about the presence of a leak, the questionable area shall be subject to a soap bubble test. Appearance of growing bubbles indicates the need for additional sealant. Ductwork leak test shall be completed with satisfactory results prior to applying insulation to ductwork exterior.

3.5 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A permanent bypass shall be provided for air handler water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of air terminal units, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.6 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.7 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 5 days for each system and shall demonstrate that the entire system is functioning according to the specifications. Coincidental chart recordings shall be made at points indicated on the drawings for the duration of the time period and shall record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

3.8 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 16 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

SECTION 16415

ELECTRICAL WORK, INTERIOR
08/96

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C12.10	(1997) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL Through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C37.16	(1997) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C57.12.10	(1988) Safety Requirements for Transformers 230 kV and Below 833/958 Through 8333/10417 kVA, Single-Phase, and 750/862 Through 60 000/80 000/100 000 kVA, Three-Phase Without Load Tap Charging; and 3750/4687 Through 60 000/80 000/100 000 kVA With Load Tap Charging
ANSI C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations
ANSI C57.12.50	(1981; R 1989) Ventilated Dry-type Distribution Transformers 1 to 500 kVA, Single-Phase; and 15 to 500 kVA, Three-Phase with High-Voltage 601 to 34

	500 Volts, Low-Voltage 120 to 600 Volts
ANSI C57.12.51	(1981; R 1989) Ventilated Dry-Type Power Transformers, 501 kVA and Larger, Three-Phase, with High-Voltage 601 to 34 500 Volts, Low-Voltage 208Y/120 to 4160 Volts
ANSI C57.12.52	(1981; R 1989) Sealed Dry-Type Power Transformers, 501 kVA and Larger, Three-Phase with High-Voltage 601 to 34 500 Volts, Low-Voltage 208Y/120 to 4160 Volts
ANSI C57.12.70	(1978; R 1993) Terminal Markings and Connections for Distribution and Power Transformers
ANSI C78.1	(1991; C78.1a; R 1996) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
ANSI C78.20	(1995) Electric Lamps - Characteristics of Incandescent Lamps A, G, PS, and Similar Shapes with E26 Medium Screw Bases
ANSI C78.21	(1995) Physical and Electrical Characteristics - Incandescent Lamps - PAR and R Shapes
ANSI C78.1350	(1990) 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	(1989) 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	(1990) 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	(1989) 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Single-Ended Metal-Halide Lamps
ANSI C78.2A	(1991) 18 & 26- Watt, Compact Fluorescent Quad Tube Lamps
ANSI C78.2B	(1992) 9 & 13-Watt, Compact Fluorescent Quad Tube Lamps
ANSI C80.5	(1995) Rigid Aluminum Conduit
ANSI C82.1	(1997) Specifications for Fluorescent Lamp

	Ballasts
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(1992; R 1997) Laminated Thermosetting Materials
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 18	Industrial, Scientific, and Medical Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.80	(1996) Terminology for Power and Distribution Transformers
IEEE C57.12.90	(1993) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C57.100	(1986; R 1992) Test Procedure for Thermal Evaluation of Oil-Immersed Distribution

	Transformers
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1994) Busways
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3; Rev 4) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

NEMA PB 1	(1995) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA PE 5	(1996) Utility Type Battery Chargers
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA SG 3	(1995) Power Switching Equipment
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 13	(1993) Electrical Nonmetallic Tubing (ENT)
NEMA VE 1	(1996) Metal Cable Tray Systems
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
NFPA 101	(1997; Errata 97-1; TIA 97-1) Life Safety Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(1993; Rev thru Jan 1995) Flexible Metal Conduit
UL 4	(1996) Armored Cable
UL 5	(1996) Surface Metal Raceways and Fittings
UL 6	(1997) Rigid Metal Conduit
UL 20	(1995; Rev thru Oct 1998) General-Use Snap Switches
UL 44	(1997; Rev Mar 1999) Thermoset-Insulated Wires and Cables
UL 50	(1995; Rev thru Oct 1997) Enclosures for Electrical Equipment

UL 67	(1993; Rev thru Nov 1995) Panelboards
UL 83	(1998) Thermoplastic-Insulated Wires and Cables
UL 98	(1994; R thru Jun 1998) Enclosed and Dead-Front Switches
UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 198L	(1995; Rev May 1995) D-C Fuses for Industrial Use
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1997; Rev thru Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; Rev thru Sep 1998) Attachment Plugs and Receptacles
UL 506	(1994; Rev Oct 1997) Specialty Transformers
UL 508	(1999) Industrial Control Equipment

UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 512	(1993; R Dec 1995) Fuseholders
UL 514A	(1996; Rev Jul 1998) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 514C	(1996; R Sep 1998) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1994; Rev thru Jul 1998) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev thru Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 674	(1994; Rev thru Oct 1998) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1999)) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 719	(1999) Nonmetallic-Sheathed Cables
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 817	(1994; Rev thru Jul 1998) Cord Sets and Power-Supply Cords
UL 844	(1995; Rev thru Aug 1997) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 854	(1996; Rev Apr 1998) Service-Entrance Cables
UL 857	(1994; Rev thru May 1999) Busways and Associated Fittings
UL 869A	(1998) Reference Standard for Service Equipment
UL 877	(1993; Rev thru May 1997) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations

UL 886	(1994; Rev thru Apr 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 916	(1998) Energy Management Equipment
UL 924	(1995; Rev thru Oct 97) Emergency Lighting and Power Equipment
UL 935	(1995; Rev thru Oct 1998)Fluorescent-Lamp Ballasts
UL 943	(1993; Rev thru May 1998)Ground-Fault Circuit-Interrupters
UL 1004	(1994; Rev thru Dec 1997) Electric Motors
UL 1010	(1995; Rev thru Dec 1996)Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1022	(1998) Line Isolation Monitors
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1047	(1995; Rev Jul 1998) Isolated Power Systems Equipment
UL 1236	(1994; Rev thru Dec 1997) Battery Chargers for Charging Engine-Starter Batteries
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1449	(1998; Second Edition) Transient Voltage Surge Suppressors
UL 1564	(1993; Rev Sep 1998) Industrial Battery Chargers
UL 1569	(1995; Rev thru Sep 1998) Metal-Clad Cables
UL 1570	(1995; Rev thru Jun 1997) Fluorescent Lighting Fixtures
UL 1571	(1995; Rev thru Jun 1997) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Jun 1997) High Intensity Discharge Lighting Fixtures
UL 1660	(1994; Rev Apr 1998) Liquid-Tight Flexible

	Nonmetallic Conduit
UL Elec Const Dir	(1998) Electrical Construction Equipment Directory

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be carefully coordinated with mechanical or structural features prior to installation and positioned according to architectural reflected ceiling plans; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate the electrical requirements of the mechanical work and provide all power related circuits, wiring, hardware and structural support, even if not shown on the drawings.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70unless more stringent requirements are indicated in this specification or on the contract drawings.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 Nameplates

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Panelboards	Control Power Transformers
Starters	Control Devices
Safety Switches	Instrument Transformers
Motor Control Centers	
Transformers	
Equipment Enclosures	
Switchgear	
Switchboards	
Motors	

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.2.7 Recessed Light Fixtures (RLF) Option

The Contractor has the option to substitute inch-pound (I-P) RLF to metric RLF. This option shall be coordinated with Section 09510 ACOUSTICAL CEILINGS.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Catalog; FIO.

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

Material, Equipment, and Fixture Lists; FIO.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures; FIO_____.

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

SD-04 Drawings

Interior Electrical Equipment; FIO.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

a. Transformers.

b. Switchboard.

c. Motors and rotating machinery.

d. Busway systems.

e. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

As-Built Drawings; FIO.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-08 Statements

Onsite Test; GA.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-09 Reports

Factory Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Field Test Plan; GA.

A detailed description of the Contractor's proposed procedures for onsite test submitted 30 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

SD-13 Certificates

Materials and Equipment; FIO.

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 BUSWAYS

UL 857. Busses shall be copper. Enclosures shall be steel. Short-circuit ratings, except as indicated, shall be in accordance with NEMA BU 1.

2.1.1 Feeder Busways

Feeder busways shall be unventilated low-impedance busway.

2.2 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. Conductors indicated to be No. 6 AWG or smaller diameter shall be copper. Conductors indicated to be No. 4 AWG and larger diameter shall be either copper or aluminum, unless otherwise indicated or required by manufacturer.

2.2.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.2.2 Aluminum Conductors

Aluminum conductors shall be AA-8000 series electrical grade aluminum alloy conductors. Type EC-1350 aluminum is unacceptable.

2.2.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83 or RHW conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.2.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.2.5 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

2.2.6 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

2.2.7 Armored Cable

UL 4; NFPA 70, Type AC cable.

2.2.8 Mineral-Insulated, Metal-Sheathed Cable

UL listed NFPA 70, type MI cable. Sheathing containing asbestos fibers shall not be used.

2.2.9 Cord Sets and Power-Supply Cords

UL 817.

AM#0003

2.3 2.3 COMMUNICATION CABLE TRAYS

NEMA VE 1 cable trays shall form a wireway system, and shall be of nominal 4 inch depth. Cable trays shall be constructed of zinc-coated steel. Trays shall include splice and end plates, dropouts, and miscellaneous

hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 24 inches.

2.3.1 2.3.1 Ladder

Ladder-type cable trays shall be of nominal 12 inch width. Rung spacing shall be on 9 inch maximum centers.

2.4 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449. Surge suppressor ratings shall be 277/480volts rms, operating voltage; 60 Hz; 3-phase; 4 wire with ground; surge current rating of 480kA per phase; maximum clamping voltage of 1000 volts. Suppression topology shall be a hybrid platform consisting of both Silicon Avalanche Diodes (SAD) and Metal Oxide Varistors (MOV). Fuses shall not be used as surge suppression.

2.5 CIRCUIT BREAKERS

2.5.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489. Circuit breakers may be installed in panelboards, switchboards, enclosures, or combination motor controllers.

2.5.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper and aluminum conductors in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.5.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.5.2 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.5.3 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.5.4 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.6 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

2.6.1 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

2.6.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATION
NEMA O	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

2.7 CONDUIT AND TUBING

2.7.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.7.2 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

2.7.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.7.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.7.5 Intermediate Metal Conduit

UL 1242.

2.7.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.7.7 Rigid Aluminum Conduit

ANSI C80.5 and UL 6.

2.7.8 Rigid Metal Conduit

UL 6.

2.7.9 Rigid Plastic Conduit

NEMA TC 2, UL 651 and UL 651A.

2.7.10 Surface Metal Electrical Raceways and Fittings

UL 5.

2.8 CONDUIT AND DEVICE BOXES AND FITTINGS

2.8.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.8.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.8.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.8.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.8.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.8.6 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.9 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.10 CONNECTORS, WIRE PRESSURE

2.10.1 For Use With Copper Conductors

UL 486A.

2.10.2 For Use With Aluminum Conductors

UL 486B.

2.11 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.11.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 in length of the sectional type driven full length into the earth.

2.11.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.12 ENCLOSURES

NEMA ICS 6 or NEMA 250 unless otherwise specified.

2.12.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.12.2 Circuit Breaker Enclosures

UL 489.

2.13 LIGHTING FIXTURES, LAMPS, BALLASTS, EMERGENCY EQUIPMENT, CONTROLS AND ACCESSORIES

The following specifications are supported and supplemented by information

and details on the drawings. Additional fixtures, if shown, shall conform to this specification. Lighting equipment installed in classified hazardous locations shall conform to UL 844. Lamps, lampholders, ballasts, transformers, electronic circuitry and other lighting system components shall be constructed according to industry standards. Equipment shall be tested and listed by a recognized independent testing laboratory for the expected installation conditions. Equipment shall conform to the standards listed below.

2.13.1 Lamps

Lamps shall be constructed to operate in the specified fixture, and shall function without derating life or output as listed in published data. Lamps shall meet the requirements of the Energy Policy Act of 1992.

a. Incandescent and tungsten halogen lamps shall be designed for 125 volt operation (except for low voltage lamps), shall be rated for minimum life of 2,000 hours, and shall have color temperature between 2,800 and 3,200 degrees Kelvin. Tungsten halogen lamps shall incorporate quartz capsule construction. Lamps shall comply with ANSI C78.20 and sections 238 and 270 of ANSI C78.21.

b. Fluorescent lamps shall have color temperature as shown . They shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used. Fluorescent lamps, including spares, shall be manufactured by one manufacturer to provide for color and performance consistency. Fluorescent lamps shall comply with ANSI C78.1. Fluorescent tube lamp efficiencies shall meet or exceed the following requirements.

T8, 32 watts	(4' lamp)	2800 lumens
T12,34 watts	(4' lamp)	2800 lumens
T8,59 watts	(8' lamp)	5700 lumens
T12,60 watts	(8' lamp)	5600 lumens
T8/U,31-32 watts	(U-tube)	2600 lumens
T12/U,34 watts	(U-tube)	2700 lumens

(1) Linear fluorescent lamps, unless otherwise indicated, shall be 4 feet long 32 watt T8, 265 mA, with minimum CRI of 75. Lamps of other lengths or types shall be used only where specified or shown. Lamps shall deliver rated life when operated on rapid start ballasts .

(2) Small compact fluorescent lamps shall be twin, double, or triple tube configuration as shown with bi-pin or four-pin snap-in base and shall have minimum CRI of 85. They shall deliver rated life when operated on ballasts as shown. 9 and 13 watt double tube lamps shall comply with ANSI C78.2B. 18 and 26 watt double tube lamps shall comply with ANSI C78.2A. Minimum starting temperature shall be 32 degrees F for twin tube lamps and for double and triple twin tube lamps without internal starter; and 15 degrees F for double and triple twin tube lamps with internal starter.

(3) Long compact fluorescent lamps shall be 18, 27, 39, 40, 50, or 55 watt bi-axial type as shown with four-pin snap-in base; shall have minimum CRI of 85; and shall have a minimum starting temperature of 50 degrees F. They shall deliver rated life when operated on rapid start ballasts .

c. High intensity discharge lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. High intensity discharge lamps shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used and shall have wattage, shape and base as shown. High intensity discharge lamps, unless otherwise shown, shall have medium or mogul screw base and minimum starting temperature of -20 degrees F. Metal halide lamps, unless otherwise shown, shall have minimum CRI of 65; color temperature of 4,300 degrees Kelvin; shall be -BU configuration if used in base-up position; and shall be -H or high output configuration if used in horizontal position. Lamps shall comply with all applicable ANSI C78.1350, ANSI C78.1351, ANSI C78.1352, ANSI C78.1355,ANSI C78.1375, and ANSI C78.1376.

2.13.2 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp manufacturer.

a. Low voltage incandescent transformers shall be Class II UL listed 120/12 volt or 120/24 volt step-down transformers as required for the lamps shown. Transformers shall be high power factor type and shall be rated for continuous operation under the specified load. Transformers shall be encased or encased and potted, and mounted integrally within the lighting fixture unless otherwise shown.

b. Fluorescent ballasts shall comply with ANSI C82.1 and shall be mounted integrally within fluorescent fixture housing unless otherwise shown. Ballasts shall have maximum current crest factor of 1.7; high power factor; Class A sound rating; maximum operating case temperature of 77 degrees F above ambient; and shall be rated Class P. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture. A single ballast may be used to serve multiple fixtures if they are continuously mounted, identically controlled and factory manufactured for that installation with an integral wireway.

(1) Compact fluorescent ballasts shall comply with IEEE C62.41 Category A transient voltage variation requirements and shall be mounted integrally within compact fluorescent fixture housing unless otherwise shown. Ballasts shall have minimum ballast factor of 0.95; maximum current crest factor of 1.6; high power factor; maximum operating case temperature of 77 degrees F above ambient; shall be rated Class P; and shall have a sound rating of Class A. Ballasts shall meet FCC Class A specifications for EMI/RFI emissions. Ballasts shall operate from nominal line voltage of 277 volts at 60 Hz and maintain constant light output over a line voltage variation of $\pm$ 10%. Ballasts shall have an

end-of-lamp-life detection and shut-down circuit. Ballasts shall be UL listed and shall contain no PCBs. Ballasts shall contain potting to secure PC board, provide lead strain relief, and provide a moisture barrier.

(2) Electronic fluorescent ballasts shall comply with 47 CFR 18 for electromagnetic interference. Ballasts shall withstand line transients per IEEE C62.41, Category A. Ballasts shall have total harmonic distortion between 10 and 20%; minimum frequency of 20,000Hz; filament voltage between 2.5 and 4.5 volts; maximum starting inrush current of 20 amperes; and shall comply with the minimum Ballast Efficacy Factors shown in the table below. Minimum starting temperature shall be 50 degrees F. Ballasts shall carry a manufacturer's full warranty of three years, including a minimum $10 labor allowance per ballast.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL VOLTAGE	NUMBER OF LAMPS	MINIMUM BALLAST EFFICACY FACTOR
32W T8	rapid start linear & U-tubes	120 or 277 V	1	2.54
			2	1.44
			3	0.93
			4	0.73
34W T12	rapid start linear & U-tubes	120 or 277 V	1	2.64
			2	1.41
			3	0.93
59W T8	rapid start linear	120 or 277 V	2	0.80
60W T12	rapid start linear	120 or 277 V	2	0.80

c. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 77 degrees F above ambient.

(1) Electronic high intensity discharge ballasts shall be

constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of 0 degrees F.

(2) Magnetic high intensity discharge ballasts shall have a minimum starting temperature of -20 degrees F.

2.13.3 Fixtures

Fixtures shall be in accordance with the size, shape, appearance, finish, and performance shown. Unless otherwise indicated, lighting fixtures shall be provided with housings, junction boxes, wiring, lampholders, mounting supports, trim, hardware and accessories for a complete and operable installation. Recessed housings shall be minimum 20 gauge cold rolled or galvanized steel as shown. Extruded aluminum fixtures shall have minimum wall thickness of 0.125 inches. Plastic lenses shall be 100% virgin acrylic or as shown. Glass lenses shall be tempered. Heat resistant glass shall be borosilicate type. Conoid recessed reflector cones shall be Alzak with clear specular low iridescent finish.

a. Incandescent fixture specular reflector cone trims shall be integral to the cone and shall be finished to match. Painted trim finishes shall be white with minimum reflectance of 88%. Low voltage incandescent fixtures shall have integral step-down transformers.

b. Fluorescent fixtures shall comply with UL 1570. Recessed ceiling fixtures shall comply with NEMA LE 4. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles. Fluorescent fixture lens frames on recessed and surface mounted troffers shall be one assembly with mitered corners. Parabolic louvers shall have a low iridescent finish and 45 degree cut-off. Louver intersection joints shall be hairline type and shall conceal mounting tabs or other assembly methods. Louvers shall be free from blemishes, lines or defects which distort the visual surface. Integral ballast and wireway compartments shall be easily accessible without the use of special tools. Housings shall be constructed to include grounding necessary to start the lamps. Open fixtures shall be equipped with a sleeve, wire guard, or other positive means to prevent lamps from falling. Medium bi-pin lampholders shall be twist-in type with positive locking position. Long compact fluorescent fixtures and fixtures utilizing U-bend lamps shall have clamps or secondary lampholders to support the free ends of the lamps.

c. High intensity discharge fixture shall comply with UL 1572. Recessed ceiling fixtures shall comply with NEMA LE 4. Reflectors shall be anodized aluminum. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Fixtures indicated as classified or rated for hazardous locations or special service shall be designed and independently tested for the environment in which they are installed. Recessed lens fixtures shall have extruded aluminum lens frames. Ballasts shall be integral to fixtures and shall be accessible without the use of special tools. Remote ballasts

shall be encased and potted. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.

d. Emergency lighting fixtures and accessories shall be constructed and independently tested to meet the requirements of applicable codes. Batteries shall be Nicad or equal with no required maintenance, and shall have a minimum life expectancy of five years and warranty period of three years.

e. Exit Signs

Exit signs shall be ENERGY STAR compliant, thereby meeting the following requirements. Input power shall be less than 5 watts per face. Letter size and spacing shall adhere to NFPA 101. Luminance contrast shall be greater than 0.8. Average luminance shall be greater than 15 cd/m^2 measured at normal (0 degree) and 45 degree viewing angles. Minimum luminance shall be greater than 8.6 cd/m^2 measured at normal and 45 degree viewing angles. Maximum to minimum luminance shall be less than 20:1 measured at normal and 45 degree viewing angles. The manufacturer warranty for defective parts shall be at least 5 years.

2.13.4 Lampholders, Starters, and Starter Holders

UL 542

2.14 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.14.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.14.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

2.14.3 Fuses, Class H

UL 198B.

2.14.4 Fuseholders

UL 512.

2.15 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.16 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004for motors; NEMA MG 10 for energy management selection of polyphase motors. In addition to the standards listed above, motors shall be provided with efficiencies as specified in

the table "MINIMUM NOMINAL EFFICIENCIES" below.

2.16.1 Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.16.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motor efficiencies indicated in the tables apply to general-purpose, single-speed, polyphase induction motors. Applications which require definite purpose, special purpose, special frame, or special mounted polyphase induction motors are excluded from these efficiency requirements. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

kW	1200 RPM	1800 RPM	3600 RPM
0.746	82.5	85.5	80.0
1.12	86.5	86.5	85.5
1.49	87.5	86.5	86.5
2.24	89.5	89.5	86.5
3.73	89.5	89.5	89.5
5.60	91.7	91.0	89.5
7.46	91.7	91.7	90.2
11.2	92.4	93.0	91.0
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	93.6
44.8	95.0	95.0	94.1
56.9	95.0	95.0	94.5
74.6	95.0	95.4	94.5
93.3	95.4	95.4	95.0
112.0	95.8	95.8	95.4
149.0	95.4	95.8	95.4
187.0	95.4	96.2	95.8
224.0	95.4	95.0	95.4
261.0	94.5	95.4	95.0
298.0	94.1	95.8	95.0
336.0	94.5	95.4	95.4
373.0	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

TOTALLY ENCLOSED FAN-COOLED MOTORS

kW	1200 RPM	1800 RPM	3600 RPM
0.746	82.5	85.5	78.5
1.12	87.5	86.5	85.5
1.49	88.5	86.5	86.5
2.24	89.5	89.5	88.5
3.73	89.5	89.5	89.5
5.60	91.7	91.7	91.0
7.46	91.7	91.7	91.7
11.2	92.4	92.4	91.7
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	94.1
44.8	94.5	95.0	94.1
56.9	95.0	95.4	94.5
74.6	95.4	95.4	95.0
93.3	95.4	95.4	95.4
112.0	95.8	95.8	95.4
149.0	95.8	96.2	95.8
187.0	95.6	96.2	95.9
224.0	95.4	96.1	95.8
261.0	94.5	96.2	94.8
298.0	94.5	95.8	94.5
336.0	94.5	94.5	94.5
373.0	94.5	94.5	94.5

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	80.0
1.5	86.5	86.5	85.5
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	93.6
60	95.0	95.0	94.1
75	95.0	95.0	94.5
100	95.0	95.4	94.5
125	95.4	95.4	95.0
150	95.8	95.8	95.4
200	95.4	95.8	95.4
250	95.4	96.2	95.8
300	95.4	95.0	95.4
350	94.5	95.4	95.0
400	94.1	95.8	95.0

TOTALLY ENCLOSED FAN-COOLED MOTORS

450	94.5	95.4	95.4
500	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	94.1
60	94.5	95.0	94.1
75	95.0	95.4	94.5
100	95.4	95.4	95.0
125	95.4	95.4	95.4
150	95.8	95.8	95.4
200	95.8	96.2	95.8
250	95.6	96.2	95.9
300	95.4	96.1	95.8
350	94.5	96.2	94.8
400	94.5	95.8	94.5
450	94.5	94.5	94.5
500	94.5	94.5	94.5

2.17 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.17.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.17.2 Motor Starters

Combination starters shall be provided with circuit breakers, .

2.17.2.1 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors 25 hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starter having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic

unloaders.

2.17.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.17.4 Low-Voltage Motor Overload Relays

2.17.4.1 General

Thermal overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70.

2.17.4.2 Construction

Manual reset type thermal relay shall be bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.17.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.17.5 Automatic Control Devices

2.17.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

2.17.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.17.5.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.18 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.19 RECEPTACLES

2.19.1 Heavy Duty Grade

NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

2.19.2 Standard Grade

UL 498.

2.19.3 Ground Fault Interrupters

UL 943, Class A or B.

2.19.4 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Single and Duplex, 15-Ampere and 20-Ampere, 125 Volt

15-ampere, non-locking: NEMA type 5-15R, locking: NEMA type L5-15R,
20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

2.20 Service Entrance Equipment

UL 869A.

2.21 SPLICE, CONDUCTOR

UL 486C.

2.22 POWER-SWITCHGEAR ASSEMBLIES INCLUDING SWITCHBOARDS

Assemblies shall be metal-enclosed, freestanding general-purpose ventilated type in accordance with NEMA PB 2, UL 891, and IEEE C37.20.1 and shall be installed to provide front and rear access. Busses shall be copper. Assembly shall be approximately 90 inches high; arrangement of circuit breakers and other items specified shall be as indicated. The withstand rating and interrupting capacity of the switchboards and circuit breakers shall be based on the maximum fault current available.

2.22.1 Circuit Breakers

Circuit breakers shall be stationary molded-case circuit breakers or insulated-case, systems type circuit breakers.

2.22.2 Auxiliary Equipment

2.22.2.1 Instruments

Instruments shall be long scale, 6.8 inches minimum, semiflush rectangular, indicating or digital switchboard type, mounted at eye level.

a. Ammeter, range 0 to 2000 amperes, complete with selector switch having off position and positions to read each phase current.

b. Voltmeter, range 0 to 300 volts, complete with selector switch having off position and positions to read each phase to neutral voltage.

2.23 SNAP SWITCHES

UL 20.

2.24 TAPES

2.24.1 Plastic Tape

UL 510.

2.24.2 Rubber Tape

UL 510.

2.25 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye windings, except as indicated. "T" connections may be used for transformers rated 15 kVA or below.

2.25.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, ventilated . Transformers shall be provided in NEMA 1 enclosure.

2.25.2 Average Sound Level

The average sound level in decibels (dB) of transformers shall not exceed the following dB level at 12 inches for the applicable kVA rating range listed unless otherwise indicated:

kVA Range	dB Sound Level
1-50	50
51-150	55
151-300	58
301-500	60
501-700	62
701-1000	64
1001-1500	65
1501 & above	70

2.26 ELECTRIC METERS

Electric meters shall be as specified in SECTION 13815, Automated Meter Reading System.

2.27 INSTRUMENT TRANSFORMERS

2.27.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.27.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall be not less than 1.5 . Other thermal and mechanical ratings of current transformer and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit

breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accidental open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.27.2.1 Current Transformers for kWH and Demand Metering (Low Voltage)

Current transformers shall conform to IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3 through B-0.9, with a minimum RF of 1.5 at 30 degrees C, with 600-volt insulation, and 10 kV BIL. Provide butyl-molded, window-type current transformers mounted in the switchboard.

2.27.2.2 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of 0.3. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.28 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

2.34 Neutral Insertion Filter with Intergral Transformer

2.34.1 Neutral Insertion Filter

Neutral insertion filters shall be a series connected, bi-directional, passive device. Filter shall modify the input current waveform at single phase loads, provide an increase in load power factor, decrease branch and feeder neutral current and reduce rms phase currents compared to non-filtered circuitry. The filter shall modify the input current wave forms required by single-phase switch mode power supplies and other non-linear loads in order to reduce the 3rd harmonic currents demanded by such loads. The resultant reduction in 3rd harmonic current should create a significant decrease in current carried by the neutral conductor of a three-phase four-wire distribution system. Reduction in harmonics shall be bi-directional, occurring on both the line and load side of the device, and shall be realized even when measured at the loads. Filter shall be totally passive in operation and shall contain no components that operate by switching or actively modifying the voltage or current waveform. Filters shall be rated 120/208 volts, 60Hz. Operating temperature shall be 0 to 40 degrees C.

2.34.2 Transformers

Transformers shall be a general purpose, dry-type, self-cooled, ventilated, three-phase transformer having two windings per phase. Core and coil shall be copper. Transformers shall be rated 480 volts delta primary to 208/120

volts, 3 phase, 4 wire, wye, secondary. Transformers shall have 220 degrees C insulation system with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers. Transformers shall be provided with an electrostatic shield.

2.34.3 Product listing:
UL 508

2.34.4 Submittal Data

Submittal data shall be as required by paragraph SUBMITTALS SD-01 Data, and shall include the following:

a. Ratings (voltage, frequency, KVA)

b. 3rd harmonic reduction both upstream and downstream of connecting point.

c. Current crest factor reduction.

d. Current THD reduction.

e. rms neutral current reduction.

2.34.5 KVA Ratings

KVA ratings shall be as shown on the drawings.

2.34.6 Enclosure

Units shall be provided in a NEMA type 1 steel enclosure protected by plating and/or paint. Screened ventilation openings shall be provided. Boltholes shall be provided for wall mounting where required.

2.34.7 Installation

The unit shall connect directly to the neutral conductor or conductors. Connection shall be through power distribution blocks equipped with pressure terminals. Neutral and grounding connections shall be at the filter neutral block and shall be as required by the manufacturer's installation instructions.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance

cannot be obtained with a single rod, 2 additional rods not less than 6 feet on centers, or if sectional type rods are used, 2 additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in conduit. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed

in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section 07840FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.6 Supports

Metallic conduits and tubing,and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 10 feet.

3.2.1.9 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter.

3.2.2 Busway Systems

Busway systems shall be of the voltage, capacity, and phase characteristics indicated. Vertical runs of busways within 6 feet of the floor shall have solid enclosures. Busways shall be supported at intervals not exceeding 5 feet, and shall be braced properly to prevent lateral movement. Busways penetrating walls or floors shall be provided with flanges to completely close wall or floor openings.

3.2.3 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.3.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.3.2 Use of Aluminum Conductors in Lieu of Copper

Unless otherwise indicated, the Contractor may substitute aluminum conductors in lieu of copper conductors for copper sizes No. 4 AWG and larger. Should the Contractor choose to provide aluminum for conductors, the Contractor shall be responsible for increasing conductor size to have same ampacity as copper size indicated; increasing conduit and pull box sizes to accommodate larger size aluminum conductors in accordance with NFPA 70; ensuring that pulling tension rating of aluminum conductors is sufficient; providing panelboards that are UL listed for use with aluminum, and so labelled; relocating equipment, modifying equipment terminations, resizing equipment; and resolving problems that are a direct result of providing aluminum conductors in lieu of copper.

3.2.3.3 Cable Systems

Cable systems shall be installed where indicated. Cables shall be installed concealed behind ceiling or wall finish where practicable.

Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes. Exposed nonmetallic-sheathed cables less than 4 feet above floors shall be protected from mechanical injury by installation in conduit or tubing.

3.2.3.4 Mineral-Insulated Cable

Mineral-insulated, metal-sheathed cable system, Type MI, may be used in lieu of exposed conduit and wiring. Conductor sizes shall be not less than those indicated for the conduit installation. Cables shall be fastened within 12 inches of each turn or offset and at intervals of not more than 6 feet. Cable terminations shall be made in accordance with manufacturer's recommendations.

3.2.3.5 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

b. Aluminum Conductors, 600 Volt and Under: Splices of aluminum conductors shall be made with a UL listed, solderless, compression-type, aluminum bodied connector, stamped for AL or AL/CU. Aluminum contact surfaces of conductors shall be cleaned with a wire brush and covered with anti-oxidant joint compound prior to making of connections. Any excess joint compound shall be wiped away after installing the connector. Insulate the connection with tape or heat-shrink type insulating material equivalent to the conductor insulation.

3.2.3.6 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors

and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).
277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).
120/240-volt, 1-phase: Black and red.

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be NEMA 1 or as shown. Boxes in other locations shall be sheet steel except that aluminum boxes may be used

with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of steel with baked enamel finish or impact-resistant plastic and shall be ivory . Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.5.2.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.5.2.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise

indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use. .

3.5.3 Receptacles, 15-Ampere, 250-Volt

Receptacles, 15-ampere, 250-volt, shall be duplex two-pole, three-wire, grounding type with bodies of ivory phenolic compound supported by mounting yoke having plaster ears. The third grounding pole shall be connected to the metal yoke. Each receptacle shall be provided with a mating cord-grip plug.

3.5.4 Receptacles, 20-Ampere, 250-Volt

Receptacles, single, 20-ampere, 250-volt, shall be ivory molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with appropriate mating cord-grip plug.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 15-ampere 277 -volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the type indicated in paragraph POWER SWITCHGEAR ASSEMBLIES INCLUDING SWITCHBOARDS with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 PANELBOARDS AND LOADCENTERS

Circuit breakers and switches capable of being locked in the open position shall not be used as a motor disconnecting means . Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper .

3.8.1 Loadcenters

Loadcenters shall be circuit breaker equipped.

3.8.2 Panelboards

Panelboards shall be circuit breaker equipped as indicated on the drawings.

3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as specified.

3.9.1 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds.

3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, shall have tested interrupting capacity not less than 100,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.9.3 Continuous Current Ratings (600 Amperes and Smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class J, current-limiting, nontime-delay with 200,000 amperes interrupting capacity.

3.9.4 Continuous Current Ratings (Greater than 600 Amperes)

Service entrance and feeder circuit fuses (greater than 600 amperes) shall be Class L, current-limiting, nontime-delay with 200,000 amperes interrupting capacity.

3.9.5 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.10 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.11 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

3.12 MOTOR CONTROL

Each motor or group of motors requiring a single control shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.12.1 Reduced-Voltage Controllers

Reduced-voltage controllers shall be provided for polyphase motors 25 hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starters or part winding increment starters having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

3.12.2 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.12.3 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

3.13 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means located adjacent to the motor, even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.14 TRANSFORMER INSTALLATION

Three-phase transformers shall be connected only in a delta-wye or wye-delta configuration as indicated . "T" connections may be used for transformers rated at 15 kVA or below.. Transformers to be located within the building may be provided in the manufacturer's standard, ventilated indoor enclosure designed for use in 40 degrees C ambient temperature, unless otherwise indicated.

3.15 LIGHTING FIXTURES, LAMPS AND BALLASTS

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

3.15.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project

completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15% of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. 10% spare lamps of each type, from the original manufacturer, shall be provided.

3.15.2 Lighting Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.15.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

3.15.2.2 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on or from the ceiling as shown. Installation and support of fixtures shall be in accordance with NFPA 70 and manufacturer's recommendations. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling, in conformance withUL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the ceiling panel structural supports.

3.15.2.3 Fixtures for Installation in Grid Type Ceilings

Fixtures for installation in grid type ceilings which are smaller than a full tile shall be centered in the tile. 1 by 4 foot fixtures shall be mounted along the grid rail as shown. Work above the ceiling shall be coordinated among the trades to provide the lighting layout shown. Fixtures mounted to the grid shall have trim exactly compatible with the grid. Contractor shall coordinate trims with ceiling trades prior to ordering fixtures. Metric fixtures shall be designed to fit the metric grid specified. Fixtures in continuous rows shall be coordinated between trades prior to ordering. Fixtures shall be mounted using independent supports capable of supporting the entire weight of the fixture. No fixture shall rest solely on the ceiling grid. Recessed fixtures installed in seismic areas should be installed utilizing specially designed seismic clips. Junction boxes shall be supported at four points.

3.15.2.4 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers or hand-straights

so that they hang plumb. Pendants, rods, or chains 4 feet or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degrees of separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 10 feet or as recommended by the manufacturer, whichever is less.

Suspended fixtures installed in seismic areas shall have 45% swivel hangers and shall be located with no obstructions within the 45% range in all directions. The stem, canopy and fixture shall be capable of 45% swing.

3.15.3 Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp as designated by the manufacturer.

3.15.4 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

3.16 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

3.17 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.17.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.17.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment and terminated.

3.17.3 Food Service Equipment Provided Under Other Sections

Wiring shall be extended to the equipment and terminated.

3.18 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.19 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTING, GENERAL.

3.20 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

3.21 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 30 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.21.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.21.2 Ground-Resistance Tests

The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of

separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms .

3.21.3 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.21.3.1 Medium Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

c. DC high-potential test.

3.21.3.2 Low Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

3.21.4 Metal Enclosed Bus Duct Tests

a. Insulation Resistance phase-to-phase, all combinations.

b. Insulation resistance phase-to-ground, each phase.

c. AC or DC high-potential test.

d. Phase rotation test.

3.21.5 Motor Tests

a. Phase rotation test to ensure proper directions.

b. Operation and sequence of reduced voltage starters.

c. High potential test on each winding to ground.

d. Insulation resistance of each winding to ground.

e. Vibration test.

f. Dielectric absorption test on motor .

3.21.6 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers 150 kVA and above.

a. Insulation resistance test phase-to-ground, each phase.

b. Turns ratio test.

3.21.7 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

3.21.7.1 Circuit Breakers, Molded Case

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Manual operation of the breaker.

3.22 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.23 FIELD SERVICE

3.23.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training shall be submitted.

3.23.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more

field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

3.24 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16770

RADIO AND PUBLIC ADDRESS SYSTEMS
07/89

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.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/EIA/310-D	(1992) Cabinets, Racks, Panels, and Associated Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

[AM#3]
1.2 SYSTEM DESCRIPTION

The radio and public address system shall consist of an audio distribution network to include amplifiers, mixers, microphones, speakers, cabling, and any ancillary components required to meet the required system configuration and operation.

1.2.1 Multi-Channel System

The system in the briefing areas shall provide multiple inputs for distribution over an audio network to each room and to speakers as indicated. Each channel shall be separate, and equipment for each channel shall be identical, except for alternate program inputs which shall be suitable for the alternate source specified. The system shall include amplifiers, VCR inputs, microphone inputs, microphones, microphone outlet receptacles, and all accessories required as shown on the drawings.

1.2.2 Multi-Channel System with Paging

Each system in the waiting areas shall include microphones, microphone outlet receptacles, two orthree microphone inputs as indicated with preamplifiers, inputs for telephone, CATV, and other program sources as indicated on the drawings, all channel paging, control for each input, power amplifying equipment, and accessories required to output the public address and paging audio signals through selected portions of the audio distribution network as indicated. The paging signal shall replace all channels of the radio system output, when the paging function is activated.

1.2.3 System Performance

The system shall provide even sound distribution throughout the designated area, plus or minus 3 dB for the 1-octave band centered at 4000 Hz. The system shall provide uniform frequency response throughout the designated area, plus or minus 3 dB as measured with 1/3-octave bands of pink noise at locations across the designated area selected by the Contracting Officer. The system shall be capable of delivering 85 dB average program level with additional 10 dB peaking margin sound pressure level (SPL) to any location in the area at an acoustic distortion level below 5 percent total harmonic distortion (THD). Unless otherwise specified the sound pressure reference level is 20 micro Pascal (0.00002 Newtons per square meter).

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-04 Drawings

Radio and Public Address System; FIO.

Detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-09 Reports

Test Plan; FIO.

Test plan and test procedures for the acceptance tests. The test plan and test procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements specified. The procedure shall also explain methods for simulating the necessary conditions of operation to demonstrate system performance.

Acceptance Tests; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The reports shall include the manufacturer, model number, and serial number of test

equipment used in each test. Each report shall indicate the final position of controls and operating mode of the system.

SD-19 Operation and Maintenance Manuals

Radio and Public Address System; FIO.

Six copies of the operation manual outlining the step-by-step procedures required for system start up, operation, and shutdown. The manual shall include equipment layout and schematics of simplified wiring and control diagrams of the system as installed, the manufacturer's name, model number, and brief description of all equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The manual shall include equipment layout and schematics and simplified wiring and control diagrams of the system.

1.4 DELIVERY AND STORAGE

Equipment placed in storage until installation time shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.5 VERIFICATION OF DIMENSIONS

The Contractor shall become familiar with the details of the work and working conditions, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancies before performing the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Material and equipment to be provided shall be the standard products of a manufacturer regularly engaged in the manufacture of such products, and shall essentially duplicate material and equipment that have been in satisfactory use at least 2 years. All components used in the system shall be commercial designs that comply with the requirements specified. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.1 Identical Items

Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

2.1.2 Nameplates

Each major component of equipment shall have the manufacturer's name, address, model and catalog number, and serial number on a plate secured to the equipment.

[AM#3]2.2 MIXER-PREAMPLIFIER

Mixer-preamplifier shall as a minimum conform to the following specifications:

Rated Output:	18 dB
Frequency Response:	Plus or Minus 1 dB, 20 - 20,000 Hz
Distortion:	Less than 0.2 percent, 20 - 20,000 Hz
Signal to noise:	Microphone - 60 dB Aux - 70 dB
Inputs:	5 independent balanced low-impedence, transformer-isolated
Input Sensitivity:	Microphone - 0.003 volts Aux - 0.125 volts Magnetic Cartridge - 0.0005 volts
Input Channel	
Isolation:	80 dB minimum
Tone Controls:	Plus or Minus 10 dB range at 50 and 15,000 Hz
Power Requirement:	110-125 Vac 60 Hz

[AM#32.3 POWER AMPLIFIERS

Power amplifiers as a minimum conform to the following specifications:

Rated power output:	150 watts RMS
Frequency Response:	Plus or Minus 2 dB, 60-13,000 Hz
Distortion:	Less than 2 percent at RPO, 600-13,000 Hz
Input Impedance:	50 k ohm unbalanced
Output Impedance:	83.3, 10.4, 8.0, and 4.0 ohms
Output voltage:	70.7, 25, 22, and 15.5 volts
Power Requirement:	110-125 Vac 60 Hz

[AM#3]2.4 MIXER AMPLIFIER

Mixer amplifier shall as a minimum conform to the following specifications:

Rated Power Output:	60 watts RMS
Frequency Response:	Plus or Minus 2 dB, 60-13,000 Hz

Distortion: Less than 1 percent at RPO, 60 - 13,000 Hz

Inputs: As shown on the drawings

Output Impedance: Balanced 4, 8, and 16 ohms

Output Voltage: 25 and 70 volts

Power Requirement: 110-125 Vac 60 Hz

2.5 MICROPHONES

Microphones shall as a minimum conform to the following specifications:

Application: Floor stand in the briefing area and Desk in all the offices.

Element: Dynamic

Frequency Response: 50 - 12,000 Hz

Impedance: 250 ohms (nominal)

Front-to-back Ratio: 20 dB

2.5.1 Microphone Jack

Each outlet for microphones shall consist of a standard outlet box, flush-mounted, and fitted with a three-pole, polarized, locking-type, female microphone jack and a corrosion resistant-steel device plate.

2.5.2 Microphone Stand

Each microphone shall have an associated stand which as a minimum shall consist of 35 by 62 inch chrome tube assembly with grip-action for locking control. Desk applications shall be as a minimum constructed of chrome tubing with a charcoal finish.

[AM#3]2.6 LOUDSPEAKERS

2.6.1 Cone Speaker

The cone speaker shall as a minimum conform to the following specifications:

Application: Ceiling

Frequency range: 60 to 12,000 Hz

Power Rating: Normal - 7 watts
Peak - 10 watts

Voice Coil Impedance: 8 ohms

Line Matching

Transformer Type:	25/70 volt line
Capacity:	2 watts
Magnet:	8 ounces or greater
Primary Taps:	0.5, 1, and 2 watts
Primary Impedance:	25 volts - 1250, 625, and 312 ohms 70 volts - 10k, 5k, and 2.5k ohms
Frequency Response:	30 - 20,000 Hz
Insertion Loss:	Less than 1 dB

2.6.2 Speaker Enclosures

Wall baffle or column speaker enclosures shall be of the tuned-port design for precise balancing and tuning of the speaker. The enclosures shall be constructed throughout of 3/4 inch, high density board, with screwed and glued joints, durably braced, and padded with fiberglass where acoustically required.

[AM#3]2.7 PRIORITY RELAYS AND CONTROLS

Priority relays and controls required to accomplish operations specified shall be provided. Relays shall be completely enclosed with a plastic dust cover for maximum protection against foreign matter, and shall be plug-in type. Relays shall be provided with a diode wired across the relay coil for transient suppression and shall be installed utilizing factory-prewired, rack-mounted receptacle strips. Coil shall be maximum 24 volts dc.

2.8 SWITCHES AND CONTROLS

2.8.1 Radio System Control Switch

A volume control shall be installed with a switch at each station and shall be of the auto transformer type and set so that the maximum volume is sufficient for the area while not disturbing adjacent areas. If the sound for the televisionis turned down or off, the paging signal shall override controls. Each device plate shall be satin-finished, corrosion-resisting steel permanently marked to indicate the channel selected.

2.9 EQUIPMENT RACKS

Equipment shall be mounted on 19 inch racks in accordance with EIA ANSI/EIA/310-D and located as shown on drawings. Ventilated rear panels, solid side panels, and solid top panels shall be provided. Perforations or louvers may be provided in front panels to ensure adequate ventilation of equipment. The racks and panels shall be factory finished with a uniform baked enamel over rust inhibiting primer.

2.10 SPEAKER AND MICROPHONE CABLE

Cables shall be of the gauge required depending upon the cable run length.

In no case shall any cable be used which is smaller than 20 AWG. Insulation on the conductors shall be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.009 inch. Cables shall be shielded with a 34-gauge tinned soft copper strand formed into a braid. Cables shall be jacketed with a PVC compound. The jacket thickness shall be 0.0200 inch minimum.

2.11 POWER SURGE PROTECTION

Major components of the system such as power amplifiers, mixer-preamplifiers, phonographs, and tuners, shall have a device, whether internal or external, which provides protection against voltage spikes and current surges originating from commercial power sources.

2.12 SIGNAL SURGE PROTECTION

Major components of the system shall have internal protection circuits which protects the component from mismatched loads, direct current, and shorted output lines.

PART 3 EXECUTION

3.1 INSTALLATION

All equipment shall be installed as indicated and specified, and in accordance with the manufacturer's recommendations except where otherwise indicated. Equipment mounted out-of-doors or subject to inclement conditions shall be weatherproofed.

3.1.1 Equipment Racks

Racks shall be mounted side-by-side and bolted together. Items of the same function shall be grouped together, either vertically or side-by-side. Controls shall be symmetrically arranged at a height as shown. Tape and compact discequipment shall be at a height above the floor as shown. Audio input and interconnections shall be made with approved shielded cable and plug connectors; output connections may be screw terminal type. All connections to power supplies shall utilize standard male plug and female receptacle connectors with the female receptacle being the source side of the connection. Inputs, outputs, interconnections, test points, and relays shall be accessible at the rear of the equipment rack for maintenance and testing. Each item shall be removable from the rack without disturbing other items or connections. Empty space in equipment racks shall be covered by blank panels so that the entire front of the rack is occupied by panels.

3.1.2 Wiring

Wiring shall be installed in rigid conduit, intermediate metal conduit, cable trays, or electric metallic tubing as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Wiring for microphone, grounding, line level, video, speaker and power cables shall be isolated from each other by physical isolation and metallical shielding. Shielding shall be terminated at only one end.

3.2 GROUNDING

All grounding practices shall comply with NFPA 70. The antenna mast shall be separately grounded. The system shall utilize a multiple-point signal grounding scheme where conductive path connections are required between each piece of equipment and the reference ground point. An isolated ground bar for power shall be provided for the connection of the main system components. The ground bar shall be connected to the main service ground utilizing a No. 6 conductor.

3.3 ACCEPTANCE TESTS

After installation has been completed, the Contractor shall conduct acceptance tests, utilizing the approved test procedures, to demonstrate that equipment operates in accordance with specification requirements. The Contractor shall notify the Contracting Officer 20 days prior to the performance of tests. In no case shall notice be given until after the Contractor has received written Contracting Officer approval of the test plans as specified. The acceptance tests shall include originating and receiving messages at specified stations, at proper volume levels, without cross talk or noise from other links or nondesignated units.

3.4 TRAINING

The Contractor shall conduct a training course for 6 members of the operating and maintenance staff as designated by the Contracting Officer. The training course will be given at the installation during normal working hours for a total of 4 hours and shall start after the system is functionally complete but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operating and maintenance manuals, as well as demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to the start of the training course.

-- End of Section --